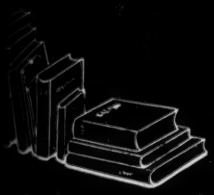
ABSTRACTS OF NORTH AMERICAN GEOLOGY



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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

ABSTRACTS OF NORTH AMERICAN GEOLOGY

April 1969

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1969

UNITED STATES DEPARTMENT OF THE INTERIOR

WALTER J. HICKEL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. Price 75 cents (single copy). Subscription price: $9.00 a year (12 monthly issues); $2.25 additional for foreign mailing. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (October 10, 1968).

(exp. 12/71)

ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

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The abstracts in this issue were prepared by Harold H. Arndt, M. H. Bergendahl, R. C. Bostrom, Arthur P. Butler, Georgianna D. Conant, Howard R. Cramer, David L. Durham, Henry Faul, R. P. Fischer, Katherine A. Friberg, Andrew Griscom, Bettie S. Hackman, Anna Hietanen-Makela, John W. Hosterman, Virginia M. Jussen, Elisabeth S. Loud, Harold E. Malde, Mildred C. Mead, Virginia S. Neuschel, Earl H. Pampeyan, L. L. Ray, Marie Siegrist, Martha S. Toulmin, Dorothy B. Vitaliano.

ABSTRACTS

04871 **Aamot, Haldor W. C.** A buoyancy-stabilized hot-point drill for glacier studies: Jour. Glaciology, v. 7, no. 51, p. 493–498, 1968; U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Rept. 215, 5 p., illus., 1968.

Hot-point drills are practical for producing holes in glaciers for ice-thickness and temperature measurements, as well as other glaciological studies. Buoyancy stabilization assures a vertical attitude of the drill and a plumb hole. This is achieved by designing a drill with a heavy hot point and a light upper section which is buoyant in the surrounding melt water. The buoyant force is less than the weight of the drill in air but its rectifying moment about the fulcrum (the tip) is greater than the tilting moment of the drill weight. Two methods to prevent refreezing of the melt water are proposed in order to permit drilling in cold ice and to assure continued access to the hole.—Author's abstract

Abdel-Hady, Mohamed. *See* Matalucci, Rudolph V. 04860

05103 **Acaroglu, Ertan R.; Graf, Walter E.** Sediment transport in conveyance systems—Pt. 2, The modes of sediment transport and their related bed forms in conveyance systems: Internat. Assoc. Sci. Hydrology Bull., v. 13, no. 3, p. 123–135, illus., table, 1968.

From results of available model investigations, functional relationships between the "shear intensity parameter" and the particle Reynolds number are determined; all data obtained in open channel and closed conduit flows are plotted. Three major zones of sediment transport modes can be distinguished: at low flow, bed load with ripples and dune forms; with increase of flow, a plane bed, some sediment in suspension; at higher flow intensities, predominant suspension. In free surface flows, antidunes are reported as bed forms, while in closed conduit a sliding bed is observed. It is established that the resulting functions given in the figured plot help to explain the various modes of sediment transport and the related bed forms in conveyance systems.—GDC

Achey, F. A. *See* Egan, W. D. 04748

Adams, William Mansfield. *See* Furumoto, Augustine S. 04667

05148 **Ahlrichs, J. L.** Hydroxyl stretching frequencies of synthetic Ni-, Al-, and Mg-hydroxy interlayers in expanding clays [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 1, p. 63–71, illus., 1968.

A prominent high frequency OH stretching vibration is associated with the layers in montmorillonite, with approximate frequencies of 3660 cm^{-1} with nickel interlayers, 3690 cm^{-1} with aluminum interlayers, and 3710 cm^{-1} with magnesium interlayers. Pleochroism studies indicate transition moment of interlayer OH to be at a relatively high angle to the planar surface of the clay crystals. Aluminum interlayers show some evidence of an additional weak absorption in the lower frequency region of 3570–3600 cm^{-1}, which can be shown to not be a water band. Deuteration studies show that flushing with D_2O at room temperature removes water, and heating at 100°C in D_2O vapor exchanges interlayer OH but not the clay crystal OH. Study of the OD stretching of the systems with deuterated

interlayers supports observations made in the OH stretching bands.—Editor's abstract

Aitken, Thomas. *See* Ewing, John. 04669

Algert, James H. *See* Nordin, Carl F., Jr. 04576

Allison, H. J. *See* Camp, C. L. 04817

04575 **Am. Soc. Civil Engineers.** (Committee on Sedimentation, Task Force on Bed Forms in Alluvial Channels). Nomenclature for bed forms in alluvial channels—Closure [to discussion of paper 4823, 1966]: Am. Soc. Civil Engineers Proc., v. 94, paper 6087, Jour. Hydraulics Div., no. HY5, p. 1333–1335, 1968.

Efforts to clarify and amplify the nomenclature proposed in paper 4823 are appreciated. The writers prefer to keep 'channel pattern' for plan-form geometry and restrict 'bed configuration' to depositional features. Chitale's tabular summary of bed forms and distinguishing characteristics provides useful guidelines. Photographs and data on barchan-like bed forms were presented by several writers; defining antidunes to include features that move upstream was discussed by others. The question of which analyses are meaningful when applied to field data on bed forms needs further study. In response to Culbertson's request for a listing of the succession of bed forms accompanying increasing or decreasing discharge, the writers submit that it is probably impossible to formulate an ordering that holds under all conditions; in general the sucession with increasing discharge is ripples, dunes, flat bed, antidunes, and chutes-and pools.—ESL

04646 **Amstutz, G. C.** Spilites and spilitic rocks, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 2 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 737–753, illus., tables, 1968.

Although widely diverse in their mineralogy and chemical composition, spilites are essentially similar to basalts in fabric, chemistry, and other features. A review of occurrences from different types of outcrop areas leads to the conclusion that the term spilite should be restricted to volcanic rocks composed of albite, chlorite, epidote, calcite, and iron oxides as major constituents (occasionally pyroxene is abundant), exhibiting a spatial symmetry between the distribution of distinct mineral phases and primary fabrics.—MS

04625 **Anderson, Charles A.** Memorial to Louis Ehrhart Reber, Jr. (1889–1966): Geol. Soc. America Proc. 1966, p. 347–350, portrait, 1968.

04824 **Anderson, Don L.; Harkrider, David G.** Universal dispersion tables—[Pt.] 2, Variational parameters for amplitudes, phase velocity and group velocity for the first four Love modes for an oceanic and a continental Earth model: Seismol. Soc. America Bull., v. 58, no. 5, p. 1407–1499, illus., tables, 1968.

The universal dispersion theory, presented in Part 1 [ibid, v. 54, 1964], is extended to allow computation of group velocity and amplitude partial derivatives. Tables giving the effect of a change in any parameter on phase velocity, group velocity, and amplitude are given for two earth models, one oceanic and one continental shield. Tables are given for the fundamental and first three higher Love modes. These tables make it possible to compute dispersion parameters for the first four Love modes for any realistic earth model or to invert observations to an earth model. Attenuation of Love waves for an arbitrary distribution of Q versus depth can also be computed by using techniques previously described.—Authors' abstract

05099 **Anderson, Don L.** Chemical inhomogeneity of the mantle: Earth and Planetary Sci. Letters, v. 5, no. 2, p. 89–94, illus., 1968.

The major portion of the increase in density and elastic properties through the transition region of the upper mantle can be attributed to phase change. However, the density increase in the Earth is slightly greater and the observed increase of the seismic velocities is slightly less than predicted on the basis of phase changes alone. The data can be reconciled with an increase in the mean atomic weight

of about 1.5 to 1.6 units. This implies an increase in the FeO/MgO ratio of about 0.17 to 0.18, the lower mantle being more iron rich than the upper mantle.—Author's abstract

05045 **Anderson, Henry W., Jr.** Ground-water resources of Island County, Washington: Washington Dept. Water Resources Water Supply Bull. 25, pt. 2, p. 1–22, 47–317, illus., tables, 1968.

Island County consists of two major islands, Whidbey and Camano, plus several smaller ones. All ground water presently used comes from aquifers in Pleistocene glacial and interglacial deposits. Total withdrawal is estimated at a billion gallons a year, but the amount of ground water in storage seems to remain fairly constant. The areal distribution of ground water is discussed for each island. About half the wells are 100–200 feet deep, and 32 percent are less than 100 feet. Well records by islands and drillers' logs of representative wells are given in an appendix. Maps show locations of wells and producing intervals, altitudes of water levels, and observation wells and hydrographs. The section on water quality is cited separately.—ESL

05047 **Anderson, M. M.; Misra, S. B.** Fossils found in the Pre-Cambrian Conception Group of south-eastern Newfoundland: Nature, v. 220, no. 5168, p. 680–681, illus., 1968.

The upper Conception mudstones in the cliffs west of Mistaken Point have been found to be fossiliferous. This is the first record of Precambrian fossils within the Conception Group, and the first unmistakable evidence of Precambrian animal life in the rocks of Newfoundland. The fossils are impressions of soft-bodied metazoans on ripple-marked bedding surfaces, and have been observed so far at five horizons within a relatively small thickness. One form in particular is very common, represented by hundreds of individuals ranging from "juveniles" about 6 cm long to "adults" 30 cm or more long. The work of describing the fauna is in progress.—DBV

05009 **Anderson, O. L.** Comments on the negative pressure dependence of the shear modulus found in some oxides: Jour. Geophys. Research, v. 73, no. 24, p. 7707–7712, illus., table, 1968.

It is shown that the value of $d\mu/dP$ (μ being shear modulus) is small and possibly negative for oxide compounds that have small relative shear modulus and have structure in which the coordination of the atoms is small. This behavior is explained by means of and early theory of ZnS, which was originally proposed by Blackman. In Blackman's model the two crystalline shear constants decrease with pressure. Blackman's equations are extended for an isotropic aggregate of ZnS, with the result that $d\mu/dP$ is negative and dK/dP is normal (K being the bulk modulus). These results for the isotropic case of Blackman's ZnS model agree remarkably well with the measured values of ZnS.—Author's abstract

Andrew, J. A. *See* Steuerwald, B. A. 05096

05035 **Archer, David R.** The upper marine limit in Little Whale River area, New Quebec [with French and Russian abs.]: Arctic, v. 21, no. 3, p. 153–160, illus., table, 1968.

Inland from the east coast of Hudson Bay, heights of raised boulder beach ridges and perched blocks were measured by altimeter at 21 sites on granite hills above a cuesta of Proterozoic rocks, basalts, and sills. As indicated by the lower limit of the perched blocks, analysis of these heights shows that the upper marine limit plane is tilted up towards James Bay at an angle of 232° ± 36°. A further calculation, made by the inclusion of two leveled values obtained by Stanley (1939) on the south coast of Richmond Gulf, gave a tilt of 277° ± 36° up towards the south end of Hudson Bay. The varied isostatic readjustment is believed to confirm a center of maximum uplift, indicating ice dispersal in the vicinity of southern Hudson Bay–James Bay during part of the Wisconsin Glaciation, perhaps earlier than that documented for the Labrador Ungava Peninsula (Ives, 1960).—GDC

Arrington, J. S., Jr. *See* Hendricks, R. W. 04573

Aubertin, G. M. *See* Blevins, R. L. 04820

04726 **Aumento, F.; Lawrence, D. E.; Plant, A. G.** The ferro-manganese pavement on San Pablo Seamount: Canada Geol. Survey Paper 68-32, 30 p., illus., tables, 1968.

Crests and flanks of San Pablo Seamount (39°N, 61°W) are enveloped by well-bedded ferro-manganese pavement; three types of deposits occur: hard, glassy slabs from crest regions, massive and friable deposits from flanks, and semiconsolidated sediments rich in detrital minerals from lower flanks. Chemical analyses show constant Mn concentrations throughout; Fe concentrations increase with depth. X-ray and electron microscope studies indicate two crystalline phases—δ-MnO_2 and $Mn_2O_3 \cdot H_2O$. Type of oxide appears to vary with depth of deposition; a higher oxidation state on upper parts of the seamount favors formation of δ-MnO_2. Electron probe analyses across the pavement reveal that: Fe concentration is constant compared to that of Mn, Mn is antithetical to that of Fe, Co and Ni are sympathetic to Mn concentration but antithetical to Fe.—*from* Authors' conclusions

Austerman, Stanley B. *See* Chikawa, Jun-ichi. 04757

Awad, I. S. *See* Sherif, M. A. 04845

Baadsgaard, H. *See* Folinsbee, R. E. 04661

04729 **Badoux, Héli.** Remarques sur la morphologie du plateau du Colorado: Soc. Vaudoise Sci. Nat. Bull. 326, v. 70, no. 1, p. 1-10, illus., 1968; *reprinted as* Lausanne Univ. Lab. Géologie, Minéralogie, Géophysique et Mus. Géol. Bull. 170, 1968.

The history of exploration, stratigraphy, tectonics, and geomorphologic evolution of the Colorado Plateau, including the Grand Canyon, are reviewed briefly. Successive stages of uplift and erosion, culminating in a denudation platform, are shown in a series of diagrammatic cross sections.—VMJ

Bailey, R. A. *See* Smith, R. L. 05122

05070 **Bain, George W.** Syngenesis and epigenesis of ores in layered rocks, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 7, Endogenous ore deposits: Prague, Academia, p. 119-136, illus., 1968.

That metallic mineralization requires provenance, whether from bodies of surface water or from tenuous solutions at depth and magmas, has been a major controversy. Environments suitable for precipitation of metallic ions are almost invariably unfavorable to life and cause either lethal or dwarfing conditions. Ore lead of age corresponding to the age of tectonism indicates epigenesis whereas an age significantly greater suggests syngenesis. It is suggested that deposits be assigned, so far as origin is concerned, to that condition raising the provenance content of a desirable mineral to interesting deposit proportions. Examples from a wide variety of enrichments are cited to illustrate the application of varied methods to identifying the nature of metal concentration up to ore content.—*from* Author's abstract

04746 **Baird, A. K.; Welday, E. E.** Precision and accuracy of silicate analyses by X-ray fluorescence, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 114-128, illus., tables, 1968.

Within the indicated compositional ranges, silicate analyses performed by X-ray emission spectrography on samples prepared by the moderate-dilution fusion method are highly precise compared with wet-analytical results; an order of magnitude better than is required to study major and minor element variations in rock bodies. This makes X-ray spectrography a powerful tool for petrologic research. Though the accuracies of silicate analyses are more difficult to assess and cannot be better than primary standards used for comparison, several lines of

evidence suggest that *prudent* working-curve calibrations provide analytical answers consistent with conventional methods when standards of similar matrices are used without application of empirically or theoretically derived correction factors.—*from* Authors' conclusions

04804 **Baird, David M.** Guide to the geology and scenery of the National Capital area: Canada Geol. Survey Misc. Rept. 15, 188 p., illus., geol. map, 1968.

This popular account of the geology of the Ottawa, Ontario, area contains sections on: the main ideas of geology and how they apply to the area, recent geological events (landslides, quick clays, earthquakes, drainage), three kinds of rocks, most ancient rocks, glaciation, where to go and what to see (eight field trips), particular features and where to see them (surficial deposits, surface features, rock formations, Precambrian rocks), mineral collecting, fossil collecting, an epilogue, and an index.—MCM

04755 **Baker, T. W.; George, J. D.; Bellamy, B. A.; Causer, R.** Fully automated high-precision X-ray diffraction, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 359–375, illus., tables, 1968.

X-ray diffraction angles are measured precisely, conveniently, and automatically by a specially designed instrument, the automatic precision X-ray goniometer connected on line to an Elliott 903B data processor. A monitor program controls two such instruments and two diffractometers simultaneously and allows a comprehensive set of experiments to be performed. The sensitivity is such that, when translated into terms of changes in the crystal-lattice parameter, a precision of one part in ten million is being attained, and indications are that absolute measurements are almost as good. The procedures, instrument, and automatic control are described, and the results of performance tests and some applications are given.—Authors' abstract

05114 **Banks, H. P.; Grierson, J. D.** *Drepanophycus spinaeformis* Göppert in the early Upper Devonian of New York State: Palaeontographica, Ser. B, v. 123, nos. 1–6, p. 113–120, illus., tables, 1968.

Leafy axes of the lycopod *Drepanophycus spinaeformis*, previously considered a Lower Devonian index fossil, have been found in two early Upper Devonian localities in Greene County, New York. They may represent occurrences of relic plants which adapted to a particular persistent ecologic niche or the product of more intensive field work.—MS

04691 **Barghoorn, E. S.** Kolichestvannaya otsenka posledovatel'nykh izmeneniy kaynozoyskikh flor severnoy Ameriki kak klyuch k paleoklimatam, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 34–42, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

Barker, R. A. *See* Luzier, J. E. 04778

Barnes, I. Lynus. *See* Finlayson, J. Bruce. 04660

04589 **Barr, D. I. H.; Herbertson, J. G.** Reply [to discusssion by T. Maddock, Jr. of 'Similitude theory applied to correlation of flume sediment transport data', 1968]: Water Resources Research, v. 4, no. 5, p. 1150–1151, 1968..

Maddock (ibid., p. 1148–1149) fails to state the manner in which he manipulates variables. The writers believe that the concept of the dimensionally homogeneous $(n+1)$ term equation can aid understanding and gives physical significance to the manipulation of variables. Additional experimentation will be required in which sufficient variables are kept constant to enable three-parameter plots of the type advocated to be drawn with the certainty that the bases of correlation are secure. Maddock's questioning of two of the equations is laid to misunderstanding.—ESL

04588 **Barr, David I. H.; Herbertson, John G.** Similitude theory applied to correlation of flume sediment transport data: Water Resources Research, v. 4, no. 2, p. 307-315, illus., table, 1968.

The method of linear proportionalities is presented and shown to be a powerful device for seeking correlation procedures for sediment transportation data. A rigorous method of correlation compatible with feasible laboratory procedures is presented and illustrated in figure form using available data. It was found that the bulk of published data was in a form unsuitable for use in a rational correlation. The authors conclude that new experimentation is required and that this could best be done by cooperation among institutions with the necessary apparatus.—*from* Authors' abstract

04832 **Barringer, Brandon.** Lanai meteorite crater apparently a myth: Meteoritics, v. 4, no. 1, p. 57-59, 1968.

A survey by air and on the ground revealed no depression at the place supposedly called Ka-imu-hoku, Hawaiian for "The Star Oven", on the island of Lanai. It had been reported as a "pit in the sand" or "the place where a meteor fell". Reasons are given for believing the name was based on native observation of a nineteenth century fireball. [Most significant is the fact that no meteoritic material was found in building a road through the supposed location].—Author's abstract

05028 **Barshad, Isaac; Kishk, Fawzy M.** Oxidation of ferrous iron in vermiculite and biotite alters fixation and replaceability of potassium: Science, v. 162, no. 3860, p. 1401-1402, tables, 1968.

Oxidation of octahedral ferrous to ferric iron in soil vermiculite clays and biotites increases the potassium-fixation capacity of vermiculites and increases the difficulty of replacing interlayer potassium in biotites. This unexpected effect is believed to be related to an increase in the attractive forces between potassium ions and oxygen ions of the surface layers which is brought about by a tilting of the dipole of the octahedral hydroxyl ions from a perpendicular position to an inclined position with respect to the cleavage plane.—Authors' abstract

Bartelli, L. J. *See* Daniels, R. B. 04985

Bar-Yosef, B. *See* Lahav, N. 04978

Basham, P. W. *See* Ellis, R. M. 04829

04699 **Bauer, A.** Mouvement et variation d'altitude de la zone d'ablation ouest (latitude moyenne 69°40'N) de l'indlandsis du Groenland entre 1948 et 1959 [with English abs.]: Medd. Grönland, v. 174, no. 1, 79 p., illus., tables, 1968.

Purpose of the study was to determine the velocity and variation in altitude of the ablation zone, distribution of ablation, accuracy of measurements, and flow of melt waters. Study of the energy budget should make it possible to measure each component factor of ablation. Triangulation along a 40 km west-east profile at latitude 69°40'N determined the horizontal movement in the ablation zone, increasing from 18 m/year at the west border to 80 m/year at the equilibrium line. Altitude variation of the profile, representing a diminution of 0.30 m/year of water, has a disputable accuracy, but the sign and order of magnitude are in accord with the observed negative balance of the icecap. The front of the icecap, carrying a border moraine, is advancing 1.5 m/year in spite of regular thinning since 1912.—*from* Author's abstract

05161 **Beards, Ronald J.; Sharp, Dennis A.** Recent exploration developments in Ontario: Jour. Canadian Petroleum Technology, v. 7, no. 3, p. 105-112, illus., 1968.

Increased exploration in Ontario during 1967 was most noticeable in offshore Lake Erie and the Hudson Bay-James Bay Lowlands. In the Canadian portion of Lake Erie six new gas pools were discovered in the Clinton-Cataract sands and the Guelph-Lockport carbonates. One of the Silurian pinnacles abandoned in southwestern Ontario as salt plugged, proved to be a successful offset well. Another

discovered in early 1968, using geophysical interpretation, raised hopes for locating more by new techniques. Silurian reefs similar to those producing in southwestern Ontario were noted in the Hudson Bay–James Bay Lowlands. Availability of well data is given, regional geologic settings are illustrated, and reef sites are located on small maps. Underlying Cambrian and Ordovician beds show promising fault traps; the long producing Devonian sediments are not yet tested beneath the lakes.—GDC

Beck, Curt W. *See* Langenheim, Jean H. 04786

Behre, Charles H., Jr. *See* Rouse, John T. 04600

Beiser, E. *See* Murthy, V. Rama. 04869

04852 **Bell, Gordon L.** Piping in the Badlands of North Dakota, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 242–257, illus., table, 1968.

Subsurface erosion and drainage, called piping, is important in the Badlands, and involve silt, bentonite, blue-gray kaolinitic clay, "scoria", and lignite. Piping develops as a short cut in the total drainage system where the physical and chemical advantages help intercept surface water. The water erodes tubes, pipes, and chambers and spurts with lumps of silt and clay to the nearest impermeable layer or its base level. Some types recognized are: dessication-stress cracks, entrainment, variable permeability subsidence, and jetting where dash rains and other sudden releases of water wet and dislodge the sediments. It is also promoted by ice action during the freeze-thaw cycle. Specific examples are cited, and the influence on engineering practice is discussed.—HRC

Bellamy, B. A. *See* Baker, T. W. 04755

04662 **Belousov, V. V.** Some problems of development of the Earth's crust and upper mantle of oceans, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 449–459, 1968.

Evidence is summarized in support of the conclusion that the history of the Earth's crust in oceanic basins involved processes that resulted in thinning of the continental crust, the disappearance of its granitic layer, and its eventual transformation in place into oceanic crust.—MS

04612 **Benavides, Victor E.; Taylor, Paul B.** Memorial to Myron T. Kozáry (1918–1966): Geol. Soc. America Proc. 1966, p. 277–278, 1968.

04789 **Bennett, J. M.; Smith, J. V.** Positions of cations and molecules in zeolites with the faujasite-type framework—[Pt.] 2, Dehydrated La-exchanged faujasite: Materials Research Bull., v. 3, no. 11, p. 865–875, illus., tables, 1968.

La-exchanged faujasite dehydrated under vacuum at 475°C, and measured at room temperature has 11.8 La in S(I), 2.6 in S(I') and 1.5 in S(II). This distribution and the interatomic distances agree with energy minimization for a simple electrostatic model in which there are few residual molecules attached to La ions. Strong occupancy of S(I') in earlier work on rare-earth exchanged faujasite and Y zeolites is ascribed at least in part to interaction with numerous residual atoms or molecules. La in S(I) is displaced along the triad axis from the origin of the unit cell: either half-atoms 0.34A apart or a strongly anisotropic artificial "temperature" factor can account for the data. The simplest explanation is that the La atom is covalently bonded to three O(3) with weaker bonding to the other three O(3) since similar distorted coordinations occur in other complex lanthanum-oxygen compounds.—Authors' abstract

Benson, Carl S. *See* Bingham, Douglas K. 04879

05135 **Benson, Carl S.** Glaciological studies on Mount Wrangell, Alaska, 1961 [with French and Russian abs.]: Arctic, v. 21, no. 3, p. 127–152, illus., tables, 1968.

Snow-pit studies involved temperature, density, hardness, and stratigraphy profiles at 5 locations in the caldera and an adjacent snow-filled crater. The facies parameters calculated for the summit area of Mount Wrangell (4,000 to 4,300 m at 62°N) compare well with the same parameters near the dry-snow line on the Greenland Ice Sheet. Mean annual temperature, based on measurements 10 m below the snow surface in the centers of the caldera and inactive craters is -20°C. Effects of volcanic heating were observed near the edge of the caldera. Accumulation, abnormally high during the 1961 summer, varies markedly with topography; the mean annual value exceeds 100 cm water equivalent in smooth central areas of the caldera and adjacent craters. Surface velocity in the caldera, measured by triangulation on a network of poles from control points on the rim, averaged about 5 cm/day^{-1} or about $20/yr^{-1}$ —*from* Author's abstract

Berg, Eduard. *See* Hanson, Kenneth. 04827

Bergendahl, M. H. *See* Koschmann, A. H. 05160

04738 **Berry, L. G.** Robert Mitchell Thompson, 1918–1967: Royal Soc. Canada Minutes Proc., 4th ser., v. 6, p. 175–179, portrait, 1968.

04649 **Bertin, Eugene P.** Recent advances in quantitative X-ray spectrometric analysis by solution techniques, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 1–22, illus., tables, 1968.

The analyst is advised to analyze samples in their original form whenever practical, but when standards are unavailable in this form, or the same substance is received in a variety of forms, when matrix effects are severe, or when an internal standard must be added, it may be necessary to reduce nonliquid samples to some other form. Advantages of solution techniques are described. A review of work done since 1960 stresses experimental techniques and treatment of data rather than specific materials and results. The work is discussed in the following categories: sensitivity, liquid-specimen cells, interaction of primary beam and liquid specimens, matrix effects, indirect (association) analysis, X-ray scatter methods, and X-ray absorption-edge spectrometry.—*from* Author's abstract

04736 **Bhattacharyya, B. K.** Analysis of aeromagnetic data over the Arctic Islands and Continental Shelf of Canada: Canada Geol. Survey Paper 68-44, 14 p., illus., 1968.

Major magnetic units observed in the area from lat 75–81°N and long 98–129°W seem to indicate a basement high, presumably subcrop of the Canadian Shield in southeastern Melville Island, beneath the Parry Islands fold belt and a probable westerly extension of the lower Paleozoic eugeosynclinal belt exposed in northern Ellesmere and Axel Heiberg Islands. Widespread folding and faulting in the area overlain by the Arctic Ocean are suggested because of evidence of abrupt changes in orientation and marked increase in intensity of polarization vectors. Depths to tops and bottoms of causative bodies are presented in contoured form. The maps indicate the probable presence of a deep linear trough trending north-south on the west of Ellef Ringnes Island and another deep sedimentary trough in the Arctic Ocean around lat 79°45'N and long 114°W.—*from* Author's abstract

04879 **Bingham, Douglas K.; Benson, Carl S.** Ash temperature variations on Mount Wrangell, Alaska: New Zealand Jour. Geology and Geophysics, v. 11, no. 3, p. 781–786, illus., 1968.

Rapid large scale temperature variations, up to 40°C within 24 hours, have been observed under the floor of a volcanically heated building on Mount Wrangell, Alaska. The temperature increases correlate well with decreases in barometric pressure. A mechanism explaining this relationship is based on Elder's steaming ground model. A decrease in barometric pressure increases the vapor pressure gradient in the soil above the water table. This increases the vapor flux which in turn increases the heat flux.—Authors' abstract

Bingham, J. W *See* Luzier, J. E. 04778

05158 **Birkelund, T.; Hansen, H. J.** Early shell growth and structures of the septa and the siphuncular tube in some Maastrichtian ammonites: Dansk Geol. Foren. Medd., v. 18, no. 1, p. 71–78, illus., 1968.

Specimens enclosed in calcareous concretions from upper Cretaceous localities of West Greenland serve as a basis for study of the submicroscopic shell structures of *Saghalinites, Scaphites*, and *Hypophylloceras* sp. The structures of the septa and siphuncular tube suggest that the hydrostatic apparatus of ammonites resembles that of nautiloids more closely than generally considered.—MS

Bisque, R. E. *See* Ong, H. Ling. 04982

Black, Robert F. *See* Frye, John C. 04839

04820 **Blevins, R. L.; Aubertin, G. M.; Holowaychuk, N.** A technique for obtaining undisturbed soil samples by freezing *in situ*: Soil Sci. Soc. America Proc., v. 32, no. 5, p. 741–742, 1968.

A freezing technique employing liquid nitrogen has been developed to freeze soil blocks *in situ*. This technique makes it possible to collect undisturbed samples from soils that are incoherent, have an abundance of roots or have a high percentage of coarse skeletal materials. The frozen block can be transported to the laboratory in a frozen state and cut into desired-size blocks for bulk density, moisture retention and micromorphological studies.—Authors' abstract

05012 **Blow, W. H.; Saito, Tsunemasa.** The morphology and taxonomy of *Globigerina mexicana* Cushman, 1925: Micropaleontology, v. 14, no. 3, p. 357–360, illus., 1968; correction, ibid., no. 4, p. 505, 1968.

The morphology of the holotype of *Globigerina mexicana* Cushman, 1925, has been re-examined and this taxon is shown to be referable to the genus *Globigerapsis* Bolli, Loeblich, and Tappan. The specimens previously referred to *"Porticulasphaera mexicana"* are here ascribed to the new genus *Orbulinoides* as *O. beckmanni* (Saito).—Authors' abstract

Bohor, Bruce F. *See* Thomas, Josephus, Jr. 05146

Bonatti, Enrico. *See* Funkhouser, John G. 05098

05020 **Bond, T. A.** A postglacial diatom assemblage from Caddo County, Oklahoma: Micropaleontology, v. 14, no. 4, p. 484–488, illus., 1968.

The diatom assemblage of the Fisher Canyon deposit in Caddo County, Oklahoma, is described and its bearing on the depositional environment and the age of formation of the deposit is discussed. The diatom assemblage indicates a lake or pond environment of postglacial age rather than the Illinoisan or Wisconsinan age suggested by previous molluscan studies.—Author's abstract

Bone, M. N. *See* White, W. R. H. 04670

04810 **Borchardt, G. A.; Theisen, A. A.; Harward, M. E.** Vesicular pores of pumice by mercury intrusion: Soil Sci. Soc. America Proc., v. 32, no. 5, p. 735–737, illus., 1968.

Objectives of the study were to evaluate mercury intrusion for measurement of the vesicular pore size distribution of pumice, to develop the methods, and to obtain preliminary information on characteristics of samples from different origins. Vesicular pores constituted about 98 percent of the fine porosity in 1–0.5 mm fractions of pumice. Average diameters of internal pores were found to be in the range of 3 to 7 μ. Distinctive curves were obtained for samples from Mt. Mazama, Glacier Peak, and Newberry Crater, and these curves appear to be useful for distinguishing between volcanic ashes of different origins. The information is expected to be significant in moisture movement, salt trapping, ion exchange, leaching, and clay mineral formation.—ESL

04655 **Bostrom, R. C.** The oceanic ridge system in the northeast Pacific: Pacific Geology, v. 1, p. 1–21, illus., table, 1968.

It has been proposed that the global oceanic-ridge tectonic system and the system of tectonic arcs mark respectively the surface trace of up-limbs and down-limbs in a convecting mantle. If this is correct there can be no region in which the oceanic-ridge system passes transitionally into the belt of arcs. Prior evidence has indicated that in the northeastern Pacific the East Pacific Rise segment of the oceanic-ridge system passes continuously into the Aleutian segment of the belt of arcs. Analysis of available geophysical evidence suggests that instead the Rise strikes inland and is responsible for tectonism affecting the Richardson Mts. and basin of the Peel River. Some evidence exists that the East Pacific Rise and the Aleutian tectonic arc are coeval. The question seems, therefore, to remain open as to whether a convective relation exists.—RCB

05104 **Bostrom, R. C.; Vali, V.** Strains recorded on a high magnification interferometric seismograph: Nature, v. 220, no. 5171, p. 1018–1020, illus., 1968.

Wave trains recorded by a phase-locked, vacuum-path laser interferometer strain seismograph are compared with those recorded on seismographs of pendulum type. A large number of wave trains and secular strains were recorded, generated by earth tides and by local and distant seismic disturbances. Some events appeared only on the interferometer and thus cannot be independently shown to be real. Typical records are reproduced.—DBV

04720 **Boyle, R. W.** The geochemistry of silver and its deposits, with notes on geochemical prospecting for the element [with French abs.]: Canada Geol. Survey Bull. 160, 264 p., illus., tables, 1968.

The author discusses the general chemistry of silver, including isotope chemistry, mineralogy, and geochemistry; the occurrence of silver in the various rock types, in soils, other weathering products, and natural waters and precipitates; and its role in the biogeochemistry of plants, animals, humus, bogs, marshes, and in coal, oil shales, petroleum, and other natural hydrocarbons. Descriptions of the various types of silver deposits aree presented—shale and sandstone deposits, skarn-types, veins, stockworks, mantos, other sedimentary rocks, silver-gold veins and lodes in volcanic flows, deposits in complex geologic environments, and oxidation and secondary enrichment deposits. Well-known or classic examples of each type are described. A chapter on various methods used in prospecting for silver is included as is a chapter on production and uses. Map 1233A, *Silver in Canada*, is in pocket.—MST

04880 **Bradley, Charles C.** The resistograph and the compressive strength of snow: Jour. Glaciology, v. 7, no. 51, p. 499–506, illus., 1968.

A recent field comparison of snow strength as measured by the snow resistograph and compressive strength as measured by direct loading to failure indicates good agreement in the range 25–400 g/cm^2.—Author's abstract

04623 **Bradley, W. H.** Memorial to Levi Fatzinger Noble (1882–1965): Geol. Soc. America Proc. 1966, p. 337–340, portrait, 1968.

04878 **Bradley, W. H.** Unmineralized fossil bacteria—A retraction: Science, v. 160, no. 3826, p. 437, illus., 1968.

Unmineralized fossil bacteria from two sources, widely separated in time and space, were described in an earlier paper (1963). Reexamination of one of the samples, the Newark Canyon limestone (Lower Cretaceous) from near Eureka, Nevada, showed that the supposed coccoid bacteria were minute spheres of fluorite produced during preparation of the material for microscopic examination. The other occurrence, particles found in calcite crystals growing in bottom mud in Green Lake, New York, are certainly not fluorite spheres but perhaps their interpretation should also be questioned.—DBV

05141 **Branson, Carl C.** Fossil freshwater sponges in Oklahoma: Oklahoma Acad. Sci. Proc. 1966, v. 47, p. 162–163, 1968.

Fresh-water sponge spicules are reported from Pleistocene sediments in two abandoned river meanders in McCurtain County, in a volcanic ash outcrop of Wisconsin age in Beaver County, from a volcanic ash deposit in a lake in Harper County containing the Bar-M local fauna, and from a calcareous phase of the LaVerne Formation of Pliocene age in Beaver County. These five Oklahoma occurrences, and others probably to be found, give information on ecology, on volcanic materials, and on distribution of potentially economic siliceous deposits.—HRC

Bredehoeft, J. D. *See* Pinder, George F. 04569

05068 **Brew, D. A.** The role of volcanism in post-Carboniferous tectonics of southeastern Alaska and nearby regions, North America, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 2, Volcanism and tectogenesis: Prague, Academia, p. 107–121, illus., 1968.

During Carboniferous and middle Permian time, the northwest trending Coast Range geanticline separated a marine basin, in which basaltic-andesitic volcanics, carbonates, and minor amounts of clastics were deposited, from a possibly tectonically more active marine basin to the southwest. In the latter basin, Lower Permian detrital clastics, some carbonates, and basaltic-andesitic volcanics overlie Carboniferous carbonate units. Lower and Middle Triassic regional uplift and deformation preceded widespread Upper Triassic volcanism. Upper Jurassic sediments were deposited over much of the region following uplift, deformation, intrusion, and erosion. The depositional basin was divided in Early Cretaceous time by uplift of the Coast Range geanticline. Subaerial volcanic breccias covered part of the uplifted terrain in Late Cretaceous and Paleocene time.—*from* Author's abstract

04696 **Briden, J. C.; Irving, E.** Spektry paleoshirot osadochnykh paleoklimaticheskikh indikatorov, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 104–129, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

04883 **Bridgwater, D.** Mechanics of flow differentiation in ultramafic and mafic sills—A discussion [of paper by S. Bhattacharji, 1967]: Jour. Geology, v. 76, no. 5, p. 596–599, 1968.

In his discussion of Bhattacharji's paper (ibid., v. 75, p. 101–112, 1967) Bridgwater doubts the existence of bostonite-anorthosite dikes in southern Greenland. Further he doubts that the composite dikes of microsyenite and trachydolerite with phenocrysts of alkali feldspar were formed by a process of flow differentiation. He suggests that these dikes formed by multiple injection of differentiating gabbroic magma, in which progressively deeper fractions of the differentiating magma were successively injected into the composite dikes.—FB

05025 **Bridgwater, D.; Harry, W. T.** Anorthosite xenoliths and plagioclase megacrysts in Precambrian intrusions of South Greenland, Pt. 1 [with Russian abs.]: Medd. Grönland, v. 185, no. 2, p. 1–67, illus., 1968; *reprinted in* Grönlands Geol. Undersögelse Bull. 77, 1968.

Feldspathic inclusions occur in Gardar igneous rocks. Some minor intrusions contain up to 80 percent included feldspathic material. The xenoliths range up to several thousand sq m, the majority being granular anorthosites. Laminated anorthosite xenoliths occur locally in gabbros. The megacrysts range up to 2 meters in length and range in composition from labradorite to calcic oligoclase. The xenoliths and megacrysts are products of early crystallization of the same Gardar magma which later gave rise to the hosts. The early removal of a large amount of plagioclase-forming material and the suggested upward concentration of alkalies are believed to be two of the major processes controlling the formation of the Gardar alkali rocks.—*from* Author's abstract

05026 **Bridgwater, D.** Anorthosite xenoliths and plagioclase megacrysts in Precambrian intrusions of South Greenland, Pt. 2 [with Russian abs.]: Medd. Grönland, v. 185, no. 2, p. 68–243, illus., 1968; *reprinted in* Grönlands Geol. Undersögelse Bull. 77, 1968.

The petrology and mineralogy of feldspathic inclusions in Gardar dikes are described. The xenoliths consist essentially of plagioclase, olivine, and Fe–Ti oxides. The plagioclase megacrysts include thin laminae of olivine, magnetite, ilmenite, and occasionally gabbroic material. The composition of the plagioclase varies between albite and bytownite, with the majority between An_{45} and An_{62}. Spectrographic barium and strontium analyses are also included; the plagioclase twinning is described and explained. A portion is devoted to the emplacement of the Gardar feldspathic dikes as well as to the petrology of the dikes. The parent body of the anorthosite dikes is an elongate mass of the order of 250–500 km long and 50–100 km broad; it is not known whether it is one body or several.—HRC

04762 **Briggs, Reginald P.** Geologic map of the Arecibo quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I–551, scale 1:20,000, section, text, 1968.

Exposed bedrock in the Arecibo quadrangle and most strata penetrated in one deep well are marine sedimentary rocks, chiefly limestone, of Cretaceous, Paleocene or Eocene age. The Tertiary system consists of the San Sebastián Formation, directly above the Eocene(?) rocks and mostly sandstone and conglomerate, and the Lares Limestone, middle to late Oligocene in age. Subdivisions of the karst topography are related to lithologic differences in underlying limestone bedrock and surficial deposits: subdued karst, sinkhole karst, mogote karst, rolling hills and irregular plains with minor karst features, a vast marsh called the Ciénaga Tiburones, and river valleys and flood plains.—MCM

Brindley, G. W. *See* Lailach, G. E. 04743

04876 **Brindley, G. W.; Gibbon, D. L.** Kaolinite layer structure—Relaxation by dehydroxylation: Science, v. 162, no. 3860, p. 1390–1391, illus., 1968.

Single-crystal electron-diffraction data reveal features of metakaolin. The basal plane parameters increase 2.2 percent in formation of metakaolin produced by heating kaolinite in air at 700°C for 12 hours. This increase results from removal of the distortion of sheet structure (relaxation).—Authors' abstract

05100 **Broecker, W. S.; Cromwell, J.; Li, Y. H.** Rates of vertical eddy diffusion near the ocean floor based on measurements of the distribution of excess ^{22}Rn: Earth and Planetary Sci. Letters, v. 5, no. 2, p. 101–105, illus., tables, 1968.

Measurements of the concentration of radon gas in near bottom water provide a means of estimating the rate of vertical mixing in the deep sea. Radon diffusing from the pore water of deep-sea sediments resides in the water column an average of five and one half days before undergoing radiodecay. The thickness of the water column over which this radon distributes itself depends therefore upon the rapidity with which the deep water mixes. Assuming that vertical mixing is accomplished by eddy diffusion, results from 9 profiles widely distributed over the world ocean show a range of coefficients from 2 to 50 cm^2/sec.—Authors' abstract

05109 **Brooks, David B.** Deep sea manganese nodules—From scientific phenomenon to world resource: Nat. Resources Jour., v. 8, no. 3, p. 401–423, 1968.

Deep-sea manganese nodules may not be considered economically efficient to mine at present, but analysis of alternative sources indicates they are close enough to the margin to influence market price. The economic characteristics of their exploitation are compared with that of current recovery from land sources. The nodules are attracting more attention than slags and low-grade deposits ever did, enough to stimulate research on their extent and quality, technological problems of deep-sea mining and processing, and security in the public domain of the continental shelf.—GDC

Brown, M. J. *See* Luebs, R. E. 04981

Brunfelt, Arild O. *See* Parker, Ronald B. 05095

Bryant, C. T. *See* Halberg, H. N. 04806

04689 **Bucher, Walter H.** Tret'ye protivostoyaniye, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 9–14, 1968; originally published in English, 1964.

This is a Russian translation of the introduction to the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

Bufe, Charles G. *See* Schimke, Gerald R. 05001

Bugenis, Claudius K. *See* Preuss, Luther E. 04751

Bukin, V. J. *See* Semenov, E. I. 04700

Burbank, Wilbur S. *See* Luedke, Robert G. 05116

Burt, R. J. *See* Luzier, J. E. 04778

04608 **Caley, John F.** Memorial to George Sherwood Hume (1893–1965): Geol. Soc. America Proc. 1966, p. 251–256, portrait, 1968.

04803 **California Dept. Water Resources.** Hydrologic data, 1967—V. 4, San Joaquin Valley: California Dept. Water Resources Bull. 130-67, v. 4, 321 p., illus., tables, 1968.

The report contains tables showing data on climate, surface-water flow, ground-water levels, ground-water recharge, and surface- and ground-water quality in the San Joaquin Valley for the 1966–67 water year. Figures show location of climatological, surface water, and surface water quality measurement stations, fluctuation of water levels in selected wells and areas, and electrical conductance at selected stations. Plates show lines of equal elevation of water in wells, spring 1967; profile of ground-water levels; cooperative study area; ground-water level changes; and well locations.—Author's abstract

Callender, Edward. *See* Rossmann, Ronald. 04875

05030 **Cameron, Francis.** What is a "have not" nation: Soc. Mining Engineers Trans., v. 241, no. 3, p. 292–298, illus., 1968.

Predictions that domestic mineral reserves are approaching exhaustion are unwarranted and may be harmful. Specific mineral forecasting errors in the Paley Report and recent expansion in mining activities and discoveries of new resources are cited in support. Suggestions are made for advancing technology to insure a progressive mineral industry capable of keeping pace with raw material needs of the nation; education of the public is of prime importance.—VSN

04817 **Camp, C. L.; Allison, H. J.; Nichols, R. H.; McGinnis, H.** Bibliography of fossil vertebrates, 1959–1963: Geol. Soc. America Mem. 117, 644 p., 1968.

This is the seventh volume in a series treating the world literature of fossil vertebrates; previous volumes each cover a five-year period, from 1928 through 1958. The bibliography includes: author catalog; subject index, with key words; systematic index, including specific epithets and names of higher taxa; and synopsis of classification of families and higher taxa.—VMJ

04849 **Campbell, David G.; Mackay, Sherman.** Bolsa Island nuclear power and desalting plant geologic investigation, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 157–175, illus., 1968.

The site, offshore in Orange County, California, is geologically suitable for the proposed construction. Drill-hole correlations and sub-bottom profiling of both shallow and great depths did not indicate any faults beneath the island site. Investigations using the sub-bottom profiler indicate that there are no fault planes seaward of the main trace of the Newport-Inglewood fault, one mile shoreward of the island, which extend to the ground surface. Soil investigations (not described in the report) indicate that the materials beneath the island site are firm and dense and not subject to liquifaction.—*from* Authors' conclusions

Campbell, F. A. *See* Lerbekmo, J. F. 05069

Campbell, J. F. *See* Furumoto, Augustine S. 04666

04894 **Canada Geological Survey.** Aeromagnetic series, Reeb Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3766, scale 1:63,360, 1968.

04895 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 H/7, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3767, scale 1:63,360, 1968.

04896 **Canada Geological Survey.** Aeromagnetic series, Kasabonika Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3768, scale 1:63,360, 1968.

04897 **Canada Geological Survey.** Aeromagnetic series, Frog River, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3769, scale 1:63,360, 1968.

04898 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 I/2, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3770, scale 1:63,360, 1968.

04899 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 I/7, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3771, scale 1:63,360, 1968.

04900 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 I/10, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3772, scale 1:63,360, 1968.

04901 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 I/15, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3773, scale 1:63,360, 1968.

04902 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 P/2, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3774, scale 1:63,360, 1968.

04903 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 P/7, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3775, scale 1:63,360, 1968.

04904 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 P/10, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3776, scale 1:63,360, 1968.

04905 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 P/15, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3777, scale 1:63,360, 1968.

04906 **Canada Geological Survey.** Aeromagnetic series, Sheet 54 A/2, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3778, scale 1:63,360, 1968.

04907 **Canada Geological Survey.** Aeromagnetic series, Sheet 54 A/7, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3779, scale 1:63,360, 1968.

04908 **Canada Geological Survey.** Aeromagnetic series, Sheet 54 A/10, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3780, scale 1:63,360, 1968.

04910 **Canada Geological Survey.** Aeromagnetic series, Wapikopa River, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3782, scale 1:63,360, 1968.

04911 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 H/8, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3783, scale 1:63,360, 1968.

04912 **Canada Geological Survey.** Aeromagnetic series, Shibogama Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3784, scale 1:63,360, 1968.

04913 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 H/16, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3785, scale 1:63,360, 1968.

04914 **Canada Geological Survey.** Aeromagnetic series, Ghost Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3786, scale 1:63,360, 1968.

04915 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 I/8, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3787, scale 1:63,360, 1968.

04916 **Canada Geological Survey.** Aeromagnetic series, Fat River, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3788, scale 1:63,360, 1968.

04917 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 I/16, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3789, scale 1:63,360, 1968.

04918 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 P/1, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3790, scale 1:63,360, 1968.

04919 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 P/8, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3791, scale 1:63,360, 1968.

04920 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 P/9, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3792, scale 1:63,360, 1968.

04921 **Canada Geological Survey.** Aeromagnetic series, Sheet 53 P/16, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3793, scale 1:63,360, 1968.

04922 **Canada Geological Survey.** Aeromagnetic series, Sheet 54 A/1, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3794, scale 1:63,360, 1968.

04923 **Canada Geological Survey.** Aeromagnetic series, Sheet 54 A/8, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3795, scale 1:63,360, 1968.

04924 **Canada Geological Survey.** Aeromagnetic series, Sheet 54 A/9, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3796, scale 1:63,360, 1968.

04925 **Canada Geological Survey.** Aeromagnetic series, Tabasokwia Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3797, scale 1:63,360, 1968.

04926 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 E/5, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3798, scale 1:63,360, 1968.

04927 **Canada Geological Survey.** Aeromagnetic series, Straight Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3799, scale 1:63,360, 1968.

04928 **Canada Geological Survey.** Aeromagnetic series, Sourdough Rapids, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3800, scale 1:63,360, 1968.

04929 **Canada Geological Survey.** Aeromagnetic series, Muzhikoba Creek, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3801, scale 1:63,360, 1968.

04930 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 L/5, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3802, scale 1:63,360, 1968.

04931 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 L/12, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3803, scale 1:63,360, 1968.

04932 **Canada Geological Survey.** Aeromagnetic series, Burning River, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3804, scale 1:63,360, 1968.

04933 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 M/4, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3805, scale 1:63,360, 1968.

04934 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 M/5, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3806, scale 1:63,360, 1968.

04935 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 M/12, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3807, scale 1:63,360, 1968.

04936 **Canada Geological Survey.** Aeromagnetic series, Fort Severn, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3808, scale 1:63,360, 1968.

04937 **Canada Geological Survey.** Aeromagnetic series, Partridge Island and part of Sheet 44 D/3, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3809, scale 1:63,360, 1968.

04938 **Canada Geological Survey.** Aeromagnetic series, Sheet 44 D/5, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3810, scale 1:63,360, 1968.

04939 **Canada Geological Survey.** Aeromagnetic series, Lastcedar Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3811, scale 1:63,360, 1968.

04940 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 E/6, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3812, scale 1:63,360, 1968.

04941 **Canada Geological Survey.** Aeromagnetic series, Tashka Rapids, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3813, scale 1:63,360, 1968.

04942 **Canada Geological Survey.** Aeromagnetic series, Meggisi Creek, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3814, scale 1:63,360, 1968.

04943 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 L/3, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3815, scale 1:63,360, 1968.

04944 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 L/6, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3816, scale 1:63,360, 1968.

04945 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 L/11, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3817, scale 1:63,360, 1968.

04946 **Canada Geological Survey.** Aeromagnetic series, Pikwakibud Creek, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3818, scale 1:63,360, 1968.

04947 **Canada Geological Survey.** Aeromagnetic series, Shagamu Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3819, scale 1:63,360, 1968.

04948 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 M/6, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3820, scale 1:63,360, 1968.

04949 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 M/14, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3822, scale 1:63,360, 1968.

04950 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 F/4, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3857, scale 1:63,360, 1968.

04951 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 F/5, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3858, scale 1:63,360, 1968.

04952 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 F/12, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3859, scale 1:63,360, 1968.

04953 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 F/13, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3860, scale 1:63,360, 1968.

04954 **Canada Geological Survey.** Aeromagnetic series, Shamattawa Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3861, scale 1:63,360, 1968.

04955 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 K/5, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3862, scale 1:63,360, 1968.

04956 **Canada Geological Survey.** Aeromagnetic series, Maminiska River, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3863, scale 1:63,360, 1968.

04957 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 K/13, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3864, scale 1:63,360, 1968.

04958 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 N/4, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3865, scale 1:63,360, 1968.

04959 **Canada Geological Survey.** Aeromagnetic series, Gooseberry Brook, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3866, scale 1:63,360, 1968.

04960 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 N/12, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3867, scale 1:63,360, 1968.

04961 **Canada Geological Survey.** Aeromagnetic series, Cultus Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4326, scale 1:63,360, 1968.

04962 **Canada Geological Survey.** Aeromagnetic series, Gladstone Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4327, scale 1:63,360, 1968.

04963 **Canada Geological Survey.** Aeromagnetic series, Talbot Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4328, scale 1:63,360, 1968.

04964 **Canada Geological Survey.** Aeromagnetic series, Rhyolite Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4329, scale 1:63,360, 1968.

04965 **Canada Geological Survey.** Aeromagnetic series, Klaza River, Yukon Territory: Canada Geol. Survey Geophysics Paper 4330, scale 1:63,360, 1968.

04966 **Canada Geological Survey.** Aeromagnetic series, Apex Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 4331, scale 1:63,360, 1968.

04967 **Canada Geological Survey.** Aeromagnetic series, Selwyn River, Yukon Territory: Canada Geol. Survey Geophysics Paper 4332, scale 1:63,360, 1968.

04968 **Canada Geological Survey.** Aeromagnetic series, Cripple Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4333, scale 1:63,360, 1968.

04969 **Canada Geological Survey.** Aeromagnetic series, Pyroxene Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 4334, scale 1:63,360, 1968.

04970 **Canada Geological Survey.** Aeromagnetic series, Rosebud Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4335, scale 1:63,360, 1968.

04971 **Canada Geological Survey.** Aeromagnetic series, Australia Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 4336, scale 1:63,360, 1968.

04972 **Canada Geological Survey.** Aeromagnetic series, Medrick Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4337, scale 1:63,360, 1968.

04973 **Canada Geological Survey.** Aeromagnetic series, Lee Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4338, scale 1:63,360, 1968.

04974 **Canada Geological Survey.** Aeromagnetic series, Upper Klondike River, Yukon Territory: Canada Geol. Survey Geophysics Paper 4339, scale 1:63,360, 1968.

04975 **Canada Geological Survey.** Aeromagnetic series, Asheweig River, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 7271, scale 1:253,440, 1968.

04976 **Canada Geological Survey.** Aeromagnetic series, Fawn River, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 7278, scale 1:253,440, 1968.

04977 **Canada Geological Survey.** Aeromagnetic series, Dickey River, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 7284, scale 1:253,440, 1968.

05042 **Canadian Association of Geographers; Warkentin, John.** (editor). Canada—A geographical interpretation: Toronto, Ontario, and London, Methuen Publications, 608 p., illus., tables, 1968.

The volume consists of nineteen chapters by twenty three authors and is divided into four parts: (1) the setting, includes the earliest occupation of the land by man; (2) lands and peoples, topics in physical and human geography shaping the pattern of Canada; (3) peoples and places; (4) relations and trends. One chapter by P. B. Clibbon and L.-E. Hamelin is cited separately.—ESL

04851 **Carder, Dean S.** Reservoir loading and local earthquakes, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 225–241, illus., 1968.

Small earthquakes associated with the filling of Lake Mead, in Nevada, Arizona, and Utah, and recent earthquakes associated with injection of waste chemicals near Denver, and reservoir loading from any other places around the world are cited. They are probable examples of the triggering of stored strain energy. The crustal block is considered to be strained to near yield but in delicate equilibrium; the equilibrium may be upset by a sudden shifting of the load or by lubrication of fractures in the rocks, thus decreasing frictional resistance. Many newly created reservoirs have no association with earthquakes because there are no ready made conditions in the crustal block containing the reservoir for the production of local earthquakes.—*from* Author's abstract

05059 **Carson, Robert J., 3d.** Physical stratigraphy of the post-Beekmantown—pre-Liberty Hall limestones, central Rockbridge County, Virginia: Tulane Studies Geology, v. 6, no. 2, p. 41–70, illus., tables, 1968.

The post-Beekmantown—pre-Liberty Hall limestones in Rockbridge County show a remarkable variation in thickness, ranging from 244 to 561 feet, and in lithology, from calcilutites to very coarse-grained limestones. A major unconformity separates the Beekmantown from the overlying Middle Ordovician. As the Beekmantown sea regressed, an erosional surface with up to several hundred feet of relief developed. Isopach and lithofacies maps and cross sections show the relations of the eight units occupying this interval. An appendix contains 24 measured sections.—ESL

04708 **Catanzaro, E. J.** The interpretation of zircon ages, *in* Radiometric dating for geologists (E. I. Hamilton and R. M. Farquhar, editors): London and New York, Interscience Publishers, p. 225–258, illus., table, 1968.

A thorough review of the Concordia technique of isotopic U-Pb age interpretation, based mostly on the author's own data, concludes that: lead loss is the principal source of discordance, high temperature is neither sufficient nor necessary for lead loss from zircon, metamictization is not sufficient to cause lead loss, episodic lead loss is a well authenticated phenomenon, and the continuous diffusion models can be made to satisfy all observed situations but often lead to conclusions that are unreasonable in comparison with other age data. Concordia interpretations of zircons from the Little Belt and Beartooth Mountains, Montana; southwestern Minnesota; Johnny Lyon and Catalina, Arizona; the Appalachian province; and Finland are illustrated.—HF

Causer, R. *See* Baker, T. W. 04755

04692 **Chaney, R. W.** Tretichnyye flory severnogo obramleniya Tikhogo okeana i svyas' ikh s klimatom, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 42–46, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

Chapin, Charles E. *See* Epis, Rudy C. 05129

Charbonneau, Brian W. *See* MacLaren, A. S. 04713

04587 **Charm, Walter B.** Outer space and the ocean: Sea Frontiers, v. 14, no. 5, p. 272–279, illus., 1968.

The slow rate of deposition of deep-sea sediments has allowed extraterrestrial spherules to accumulate in large numbers, and because the sediments have never been eroded, they contain a complete history. Estimates of annual accumulation of spherules on Earth range from 120 to 2,000,000 tons. Manufacturing processes produce similar spherules, so that scientists must be extremely careful to avoid contamination. A new method of sorting uses filters that become powerful magnets. The electron microprobee is a new analytical tool. Microtektites have also been found in deep-sea cores between Antarctica an0d Australia, deposited 700,000 yr ago at the time of a magnetic reversal.—ESL

05153 **Cheatham, J. B., Jr.** Rock breakage by crushing, blasting, and drilling: Eng. Geology—Internat. Jour., v. 2, no. 5, p. 293–314, illus., 1968.

The fundamental principles of rock fragmentation by crushing, blasting, and drilling are not well understood; however, empirical observation have provided means for predicting the energy requirements for these processes. Experimental procedures and methods of analysis used in comminution studies are described in this review. Particular emphasis is given to discussions of the role that mechanical properties of rocks play in the rock breakage processes. Estimates of the energy required to reduce rock particle size indicate that only a small portion of the total energy is utilized as surface energy and much of the energy is dissipated as thermal energy. A better understanding of brittle fracture is needed to provide a more valid theoretical basis for comminution studies.—Author's abstract

Chen, Y. *See* Lahav, N. 04978

04757 **Chikawa, Jun-ichi; Austerman, Stanley B.** X-ray double-crystal method of analyzing microstrains with BeO single crystals, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 394–400, illus., 1968.

A double-crystal arrangement was employed in the symmetrical Laué arrangement [(+n, -n) setting]. A perfect BeO crystal was used for the first crystal of the double-crystal spectrometer. To obtain a high X-ray intensity, the thickness of the crystal was made to correspond to a maximum of Pendellösung interference. A slit was placed between the first and second (specimen) crystals to select the X-rays which precisely satisfy the Bragg condition. The slit was adjusted to avoid significant Fraunhofer diffraction. In this method, the incident beam for the specimen crystal was parallel enough to obtain intrinsic rocking curves of the specimen crystal. As an application, the method was used for determination of the senses of slight strains in BeO crystals.—Authors' abstract

Christ, C. L. *See* Eberlein, G. Donald. 05027

05102 **Chung, C. L.; Scheidegger, A. E.** A thermodynamic analogy for transport processes involving a non-positive definite transported quantity: Internat. Assoc. Sci. Hydrology Bull., v. 13, no. 3, p. 88–94, illus., 1968.

Evidently, in transport processes, the analogy between energy and transported quantity works only if the latter is a nonnegative definite quantity, since energy is such a quantity. However, a case in which the behavior of nonpositive quantities as well, such as momentum, may play a part has been treated by Scheidegger (1967) in connection with the meandering of rivers. In this paper it is shown how the thermodynamic analogy of transport processes, so established, can be extended to quantities that can become negative, applying the idea of a Carnot cycle, and considering stability conditions.—GDC

04647 **Church, W. R.** Eclogites, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 2 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 755–798, illus., tables, 1968.

Eclogites have been found as inclusions in alkali basaltic flows and pipes, as layers in ultramafic intrusions, as inclusions in kimberlite pipes, as tectonic inclusions in metamorphic complexes associated with silicic and mafic gneisses and garnet- and kyanite-bearing mica schists, and as tectonic inclusions in glaucophane schists of orogenic belts. The chemistry of eclogites; here defined as metamorphic rocks composed essentially of omphacite (jadeite-bearing pyroxene) and garnet, is discussed in detail.—MS

05016 **Cifelli, Richard.** A note on the holotype of *Globorotalia fohsi* Cushman and Ellisor: Micropaleontology, v. 14, no. 3, p. 369–370, 1968.

The holotype of the foraminiferal species *Globorotalia fohsi* Cushman and Ellisor is keeled throughout its periphery, although the keel is weakly developed on the early chambers of the final whorl.—Author's abstract

Clark, D. L. *See* Steuerwald, B. A. 05096

04797 **Clark, David L.** Fossils, paleontology and evolution: Dubuque, Iowa, Wm. C. Brown Co. Publishers, 130 p., illus., 1968.

This book, one of the Foundation of Earth Science series, is designed as an introduction to paleontology for students of earth science. The main groups of fossil plants, invertebrates, and vertebrates are surveyed, and their evolution and paleoecology are interpreted in the context of geologic history. Areas of study in paleontology are outlined. The possibility of extraterrestrial life is discussed.—VMJ

04717 **Clarke, P. J.** Basement gneisses in the Mount Wright–Mount Reed area, Quebec [with French abs.]: Geol. Assoc. Canada Proc., v. 19, p. 22–36, illus., tables, 1968.

Archean granulites underlie the southern Labrador trough and extend with the Proterozoic "trough" rocks into the Grenville metamorphic province. The Grenville orogeny metamorphosed Archean and Proterozoic rocks to amphibolite facies, but some Archean rocks retain traces of previous high metamorphic rank, containing hypersthene remnants partly replaced by fine-grained biotite, garnet, quartz, and sodic plagioclase. Speckles of fine-grained mafic minerals mark location of destroyed pyroxene in a matrix of strained quartz, altered oligoclase, biotite, and younger quartz and sodic plagioclase. Complete recrystallization yields coarse grained, layered quartz, feldspar, biotite ± hornblende gneiss and migmatite. The regional structure is complex; overturning is general and in many places Proterozoic metasediments underlie the Archean gneiss in tight attenuated synclines with flat-lying axial planes.—*from* Author's abstract

04735 **Clay Minerals Society.** (Nomenclature Committee). Report of the Nomenclature Committee (1966–67) of the Clay Minerals Society: Clays and Clay Minerals, v. 16, no. 4, p. 322–324, table, 1968.

Use of the following terms is discussed: lattice; plane, sheet, and layer; and X, Y, Z, and a, b, c. A proposed classification scheme for phyllosilicates related to clay minerals is tabulated. A critical re-evaluation of anauxite is recommended, berthierine is endorsed as the name for the 1:1 mineral that has been called chamosite, and preferable terms in description of chlorite structure are agreed upon.—ESL

Cleland, N. A. *See* Sproule, J. C. 05162

05037 **Clibbon, Peter B.; Hamelin, Louis-Edmond.** Landforms, Chap. 3 *in* Canada—A geographical interpretation (John Warkentin, editor): Toronto, Ontario, and London, Methuen Publications (for Canadian Assoc. Geographers), p. 57–77, illus., 1968.

Canada is a saucer-shaped basin, almost 3,500 mi in diameter. The discontinuous mountain rim consists on the west of the Cordillera, on the east of the Appalachians and northeast seaboard mountains from Labrador to Ellesmere Island, and on the north of the Innuitian Mts. The platform of the Canadian Shield is also described and its geomorphic evolution discussed. During deglaciation, a succession of large

freshwater lakes formed along the ice front; many smaller lakes still remain. The vast Hudson Sea, in the center of the Shield, is the saucer bottom. Between the Shield and the rim is a wide ring of low plains and plateaus. Similarities and differences between physical landscapes of the St. Lawrence Lowland, interlake Ontario, plains and plateaus of the western interior, and archipelago lowlands and plateaus are described.—ESL

Clowes, R. M. *See* Kanasewich, E. R. 05063

04645 **Coats, R. R.** Basaltic andesites, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 2 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 689–736, illus., tables, 1968.

The interrelationships and nature of the primary basaltic magma, the extent of iron enrichment during differentiation, and the degree and nature of assimilation are the principal factors responsible for formation of the wide variety of andesites and basaltic andesites. Chemical and normative data from many published rock analyses are tabulated; they serve as a basis for defining the rock types and lead to the suggestion that the term andesite be restricted to intermediate rocks of the calc-alkalic, or orogenic suite.—MS

04580 **Cobb, Ernest D.** Variation of α and β values in a lined open channel—Discussion [of paper 5593 by F. J. Watts, D. B. Simons, and E. V. Richardson, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 6200, Jour. Hydraulics Div., no. HY6, p. 1560–1563, tables, 1968.

Subjects discussed in this attempt to provide further understanding of the factors affecting α and β are: the relation of α to channel and flow variables, a time-saving computation of α and β, the contribution of horizontal and vertical velocity variations to α, and the relation between α and β.—ESL

05014 **Cohen, Arthur D.; Guber, Albert L.** Production of pollen-sized "microforaminifera" from "normal" foraminifera: Micropaleontology, v. 14, no. 3, p. 361–362, illus., table, 1968.

Pollen-sized "microforaminifera" were produced from "normal-sized" calcareous foraminifera of the species *Ammonia limnetes* (Todd and Bronnimann) by the differential destruction of the test with 5 percent HC1.—Authors' abstract

04679 **Colbert, E. H.** Klimaticheskaya zonal'nost' i nazemnyye fauny, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 401–419, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

04683 **Colbert, E. H.** Vyyavleniye aridnykh i zharkikh klimatov geologicheskogo proshlogo po paleontologicheskim dannym, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 241–244, 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

04619 **Colbert, Edwin H.** Memorial to Charles Craig Mook (1887–1966): Geol. Soc. America Proc. 1966, p. 309–315, portrait, 1968.

Coleman, Robert G. *See* Taylor, Hugh P., Jr. 05054

Colgrove, Gordon L. *See* Stevenson, John S. 05079

05143 **Collins, Vernes E.; Penfound, William T.** The relation of stock pond vegetation to geological formations in Marshall County, Oklahoma: Oklahoma Acad. Sci. Proc. 1966, v. 47, p. 11–13, tables, 1968.

The vegetation of six ponds was studied in relation to the physical factors and geological formations. Ponds are in clayey soils derived from the Weno Clay, Kiamichi Clay, Fort Worth Limestone, and Duck Creek Limestone, and in sandy soils derived from the Trinity Formation and river sand. Sixty-eight plant species were examined, and the number of species was positively correlated with low water-level fluctuations and low turbidity and more closely with physical factors than with geological formations. Only one species, for instance, was encountered in ponds of all the geological formations.—*from* Authors' summary

04782 **Colton, Harold S.** Biography of Henry Hollister Robinson, 1873–1925: Plateau, v. 41, no. 2, p. 72–86, illus., portrait, 1968.

Coney, Peter J. *See* Elston, Wolfgang E. 05123

05128 **Corbett, Marshall K.** Tertiary volcanism of the Specimen–Lulu–Iron Mountain area, north-central Colorado, *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 1–37, illus., tables, 1968.

The Specimen–Lulu–Iron Mountain area in Colorado is typified by local and intense Early to mid-Tertiary volcanism associated with late stage Laramide igneous activity and tectonic events. Generally, rocks of the area characterize the basalt-andesite-rhyolite association common to orogenic belts. Consideration of stratigraphic and structural relationships, chemical and petrographic data, and age dating have led to the interpretation of stages in the development of the extrusive centers of Specimen and Lulu Mountains, and to postulations regarding petrogenetic relationships between extrusive activity and emplacement of the Never Summer stock. Comparisons made with other volcanic provinces show the Specimen–Lulu–Iron Mountain area to be intermediate between those typically alkalic and calc-alkalic.—*from* Author's abstract

04988 **Corey, John C.** Evaluation of dyes for tracing water movement in acid soils: Soil Sci., v. 106, no. 3, p. 182–187, illus., tables, 1968.

Suitable nonfluorescent dyes for illustrating streamlines in kaolinitic, acid soils are Erio Floxine 2G Supra (Acid Red 1), Crimson Gr Hi Conc. (Acid Red 14), and Alphazurine B Conc. (Acid Blue 26). None of these dyes moved as rapidly as water. Dyes with two sulfonic acid groups moved more readily through acid soils than dyes with one sulfonic acid group. Dyes were used to trace divergence of streamlines around coarse gravel lenses during unsatured flow in finely textured soils.—JWH

04826 **Cornell, C. Allin.** Engineering seismic risk analysis: Seismol. Soc. America Bull., v. 58, no. 5, p. 1583–1606, illus., tables, 1968.

This paper introduces a method for the evaluation of the seismic risk at the site of an engineering project. The results are in terms of a ground motion parameter (such as peak acceleration) versus average return period. The method incorporates the influence of all potential sources of earthquakes and the average activity rates assigned to them. Arbitrary geographical relationships between the site and potential point, line, or areal sources can be modeled with computational ease. In the range of interest, the derived distributions of maximum annual ground motions are in the form of Type I or Type II extreme value distributions, if the more commonly assumed magnitude distribution and attenuation laws are used.—Author's abstract

04884 **Cowgill, Ursula M.** Method to determine all detectable exchangeable cations using X-ray emission and optical emission spectroscopy: Appl. Spectroscopy, v. 22, no. 5, p. 415–419, tables, 1968.

One set of dried (48 h 110°C) and ground (200 mesh) lake mud samples from Linsley Pond, North Branford, Conn., were leached successively with IN, pH 6.9 ammonium acetate, and another set of samples, with doubly distilled deionized water. The

liquid was added to beakers containing either terephthalic acid or methyl cellulose and evaporated. Pressed pellets of the powder were examined. It appears that methyl cellulose is a better matrix for exchangeable cations. Limnologists interested in exchangeable cations would do well to study the alkalies, alkaline earths, and a few major metals.—ESL

04595 **Craddock, Campbell.** Memorial to Charles Leonard Bieber (1901–1965): Geol. Soc. America Proc. 1966, p. 175–179, portrait, 1968.

04723 **Cramer, Fritz H.** Silurian palynologic microfossils and paleolatitudes: Neues Jahrb. Geologie u Paläontologie Monatsh. 1968, no. 10, p. 591–597, illus., 1968.

Three distinct Silurian acritarch assemblages can be distinguised; they appear to follow Silurian paleolatitudes and should therefore be climatically dependent. The configuration of these latitude-controlled provinces does not contradict Bullard and others' (1965) essentially Wegenerian continent configuration. However, paleomagnetic data do not fix paleolatitudes, and although acritarch provinces apparently show a parallelism to the Silurian latitudes, the only safe conclusion is that the data neither support nor contradict the concept of continental drift in general.—*from* Author's conclusions

04768 **Cressman, E. R.** Geologic map of the Salvisa quadrangle, central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–760, scale 1:24,000, section, text, 1968.

Fluorite has been mined from two veins in the southern part of the Salvisa quadrangle, and other veins have been prospected for both fluorite and barite. There are no active quarries, but parts of the Tyrone Limestone, the Oregon Formation, and the Camp Nelson Limestone are quarried in nearby areas for road metal, concrete aggregate, and agricultural lime. Sand for several purposes might be available.—MCM

Crocket, J. H. *See* Harriss, Robert C. 04893

04779 **Crompton, A. W.; Jenkins, Farish A., Jr.** Molar occlusion in late Triassic mammals: Cambridge Philos. Soc. Biol. Rev., v. 43, no. 4, p. 427–458, illus., 1968.

New evidence from the African Late Triassic triconodont mammal *Megazostrodon rudnerae*, n.gen. n.sp., and the British Rhaetic (latest Triassic) primitive symmetrodont *Kuehneotherium* is used in tracing evolution of dentition of therian mammals from a primitive cynodont reptile similar to Early Triassic *Thrinaxodon*, through an eozostrodontid similar to *Megazostrodon*, to the British Rhaetic *Eozostrodon*, the Rhaetic symmetrodonts, and the Late Jurassic pantothere *Docodon*. Evolution of therian molars is shown to involve cusp rotation, as proposed in the Cope–Osborn theory (Osborn, 1895, 1907); criticisms against the theory (Simpson, 1936; Patterson, 1956) are re-evaluated. The apparent close relationship of Late Triassic mammals suggests monophyletic origin. A new classification is outlined for orders Pantotheria and Symmetrodonta.—VMJ

Cromwell, J. *See* Broecker, W. S. 05100

04570 **Crosby, James W., 3d; Johnstone, Donald L.; Drake, Charles H.; Fenton, Robert L.** Migration of pollutants in a glacial outwash environment: Water Resources Research, v. 4, no. 5, p. 1095–1114, illus., table, 1968.

A test drilling program was conducted in a drain field area of the Spokane Valley, Washington, to study the movement of pollutants in glacial outwash deposits when they are subjected to extreme pollutant loads. Contrary to what might be expected, very dry soils were found at depth beneath the drain field, and it is concluded that most of the waters are being dispersed laterally by capillary mechanisms. Much of the systemic water may ultimately be returned to the atmosphere by evapotranspiration. Moisture conditions in the drain field system strongly indicate that ground-water recharge through incident precipitation in this part of the Valley would be highly improbable. Chemical pollutants are found to travel with moisture

fronts, but fine materials are determined to be very effective in filtering bacteria within a relatively few feet of the leach bed.—Authors' abstract

05067 **Crosby, P.** Igneous differentiation of the Adirondack anorthosite series, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 2, Volcanism and tectogenesis: Prague, Academia, p. 31–48, illus., tables, 1968.

Studies on the northern edge of the Adirondack anorthosite massif generally confirm Balk's hypothesis that the anorthosite series and syenitic rocks are differentiation products of a common dioritic magma. Gravity-settling and filter-pressing in place are inadequate to explain compositional layering, block structure, and other transgressive structures between members of the anorthosite and mangerite-charnockite series. Flow differentiation modified by assimilation accounts for: the central plug of plagioclase cumulate crystals, a border zone of gabbroic anorthosite, a transitional zone of gabbroic anorthosite interlayered with mangeritic rocks having 0.5 percent disequilibrium andesine megacrysts, and a thick outer sequence of mangerite and charnockite. Fluid dynamics controlling viscosity and flow rates in liquids and liquid-solid mixtures are analyzed.—*from* Author's abstract

04693 **Crowell, J.** Otlozheniya s rasseyannymi megaklastami kak pokazateli klimata, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 69–83, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

04596 **Crowell, John C.** Memorial to Max Birkhauser (1899–1965): Geol. Soc. America Proc. 1966, p. 181–182, portrait, 1968.

04885 **Cserna, Zoltán de.** Mexico City—Its geologic setting: Geotimes, v. 13, no. 8, p. 10–12, illus., 1968.

Most of Mexico City is built on upper Tertiary and Quaternary lake fill which contrasts with the older Cretaceous-Tertiary rocks outside the metropolitan area. After folding of a thick Lower Cretaceous-Paleocene clastic wedge in early Eocene time, the area was not covered by the sea again. Block faulting in late Eocene and Oligocene time blocked drainage, creating large lakes. In the mid-Tertiary the area was covered by volcanics, most of which were carried away by south-flowing drainage forming a major valley. Toward the end of the Tertiary the valley was dammed by further volcanic activity and the lake formed behind it received 800 m of clay-silt fill. Pleistocene volcanism produced three major volcanoes and dozens of cinder cones. Early man formed small communities on beaches and islands of the lake.—ESL

05140 **Culver, James R.; Gray, Fenton.** A pedological study in the Wellington Formation: Oklahoma Acad. Sci. Proc. 1966, v. 47, p. 163–169, illus., table, 1968.

The Wellington weathereed and unweathered samples are higher in illitic and chloritic clay minerals, while the C horizon of the Waurika pedon contains mostly montmorillonitic clays. The coarse clays of the C horizon are mainly illitic and fine clay, the dominant fraction—montmorillonitic. These differences of clay mineralogy have been interpreted as evidence that the Waurika soil samples did not develop in place but formed into post-Permian sediments laid over the older landform of the Wellington Formation.—Authors' summary

Cumming, G. L. *See* Folinsbee, R. E. 04661

Cummins, H. Z. *See* Shapiro, S. M. 04783

04997 **Currie, K. L.** Mistastin Lake, Labrador—A new Canadian crater: Nature, v. 220, no. 5169, p. 776–777, illus., 1968.

The volcanic nature of the Mistastin Lake depression has been confirmed by field mapping. This crater is unusual in three respects: the volcanic apparatus is exposed

with remarkable completeness; the structure as outlined by the volcanic feeders, is markedly elliptical rather than equant; and the structure is the second in Canada whose approximate position was predicted before discovery. The Precambrian rocks of the central island display shock metamorphic features commonly thought to be diagnostic of impact scars. However, the probability that two structurally, petrologically, and temporally unusual craters would appear at predicted (on structural grounds) sites as the result of random impact of cosmic missiles seems to be negligible.—DBV

Cuttitta, Frank. *See* Rose, Harry J., Jr. 04650

Dale, Barrie. *See* Wall, David. 05013

04565 **Damon, Paul A.** Potassium–argon dating of igneous and metamorphic rocks with applications to the Basin ranges of Arizona and Sonora, *in* Radiometric dating for geologists (E. I. Hamilton and R. M. Farquhar, editors): London and New York, Interscience Publishers, p. 1–71, illus., tables, 1968.

This is a thorough technical review of the K–Ar dating method, decay constants, analytical methods and errors, argon loss, inherited argon, basic assumptions, and interpretive models. The principles developed are then applied to the analysis of age relationships of a wide variety of rocks ranging in age from Precambrian to Cenozoic, with emphasis on the interpretation of metamorphic events. Age data tend to confirm the classic view of discrete orogenic pulses roughly 40 million years apart, separated by periods of quiescence.—HF

04855 **Danehy, Edward A.** Consequences of the Elk Creek slide on the maintenance of forest access, Mendocino National Forest, California, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 300–311, illus., 1968.

The Elk Creek slide, in Potter Valley in the northern Coast Ranges of California, occurred in an area of old faulting in the Franciscan Formation, consisting predominantly of phyllite and altered serpentine. Surface and subsurface drainage and loading due to construction aggravated the site conditions which include materials frequently found to be unstable. Water was provided by an intermittent stream which not only increased pore water pressure but eroded support in the foot of the area; a fault zone provided a plane of weakness. A case is made for advanced consideration of these potentialities rather than waiting until the slide occurs before investigating the causes and cures.—HRC

04985 **Daniels, R. B.; Gamble, E. E.; Bartelli, L. J.** Eluvial bodies in B horizons of some ultisols: Soil Sci., v. 106, no. 3, p. 200–206, illus., table, 1968.

There are clay-poor bodies in the B2t horizon of many soils in the Atlantic and Gulf Coastal Plains. The authors interpret the data as indicating that these clay-poor bodies have an eluvial origin. The eluvial bodies in the B2t horizon formed independently of the A2 horizon and are probably related to high stands of the water table. The use of the lower case letter *e* is suggested as a horizon designation.—JWH

04652 **Davidson, E. S.** Water-resources investigations in a semiarid basin in Arizona, U.S.A., *in* Congress of Istanbul, 1967—Internat. Assoc. Hydrogeologists Mem., v. 8: Ankara, Turkey, Turkish Natl. Comm., Internat. Assoc. Hydrogeologists, p. 552–558, illus., 1968.

Water for domestic use, public supply, and irrigation in the Tucson basin is furnished by wells tapping the large ground-water reservoir in the permeable alluvial deposits which are more than 2,000 feet thick in the central portion. Annual pumpage exceeds annual recharge, and water levels have declined as much as 60 feet since 1940. Chemical quality of most ground water is satisfactory for present use; in the central section the water contains fluoride in objectionable amounts. Calcium, sodium, bicarbonate, and sulfate are the principal ions in solution. When suitable adjustments are made on the analog model, the model will be ready to duplicate change in water levels due to pumping since 1940. Accuracy of computation of

ground water in storage will depend upon value and completeness of correlation and geologic evaluation of the aquifers.—MCM

04654 **Davies, Gordon L.** An Irish geological pioneer in the American West—Thomas Condon (1811–1907): Irish Naturalists' Jour., v. 16, no. 4, p. 100–102, 1968.

04825 **Davies, John B.; Smith, Stewart W.** Source parameters of earthquakes, and discrimination between earthquakes and nuclear explosions: Seismol. Soc. America Bull., v. 58, no. 5, p. 1503–1517, illus., tables, 1968.

The first part of this study describes a technique by which source parameters of an earthquake can be obtained from the spectrum of compressional waves. The source parameters defined are fault length, fracture velocity, and fault-plane attitude. Two large, deep earthquakes are examined using this technique. The source parameters determined compare favorably with those obtained previously using different techniques. In the seecond section a method is proposed for discrimination between underground explosions and earthquakes. The technique utilizes the ratio of spectrums of the two classes of events where the path of propagation is common to both. On the basis of the analysis of the SHOAL event and a nearby shallow earthquake it appears that the duration as determined from the spectral ratio is almost 10 times smaller for an explosion than it is for a comparable earthquake.—Authors' abstract

Davis, G. L. *See* Hart, S. R. 04566

04823 **Decker, R. W.** A seismic event counter for active volcanoes: Seismol. Soc. America Bull., v. 58, no. 5, p. 1353–1358, illus., 1968.

Changes in the numerical frequency of microearthquakes have been observed at various active volcanoes. Identification of these periods of change can be made with a short-period, vertical seismometer driving a simple tally register counting circuit. A fully portable prototype model tested at various active volcanoes provided rapid estimations of the occurrence of microearthquakes. On Kilauea Volcano, Hawaii, the numerical results correlate very well with counts made from conventional seismograms. The device is no substitute for continuous seismic records, but provides a very simple method of monitoring changes in local seismicity which can then be evaluated by more sophisticated equipment.—Author's abstract

Dennen, William H. *See* Quesada, Antonio. 04794

04766 **Dibblee, T. W., Jr.** Geologic map of the Twentynine Palms quadrangle, San Bernardino and Riverside Counties, California: U.S. Geol. Survey Misc. Geol. Inv. Map I-561, scale 1:62,500, sections, separate text, 1968.

Map units described in the text are: Cenozoic sedimentary deposits (surficial sediments, dissected alluvial fan gravel, older surficial sediments), Mesozoic vein rock (quartz), Mesozoic plutonic and hypabyssal igneous rocks (quartz monzonite, and dike, older granitic, and dioritic rocks), and Precambrian(?) metamorphic rocks (gneissic). All mines and prospects described presumably were made in search of gold many years ago, but no production is recorded.—MCM

05157 **Dickinson, Robert G.; Leopold, Estella B.; Marvin, Richard F.** Late Cretaceous uplift and volcanism on the north flank of the San Juan Mountains, Colorado, *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 125–148, illus., tables, 1968.

Rhyodacitic flows, flow breccia, tuff breccia, and associated conglomerates, here named the Cimarron Ridge Formation, crop out in the Cimarron Ridge area on the north flank of the San Juan Mountains, Colorado. Epiclastic volcanic rocks in the formation contain pollen of Maestrichtian age, and K-Ar age determinations on mineral separates from lavas and related dikes indicate an age of about 66 m.y. The volcanic rocks were deposited unconformably on an erosion surface that truncates folded and faulted Upper Cretaceous Mancos Shale, Fruitland Formation, and Kirtland Shale. The deformation and erosion apparently occurred in Maestrichtian time inasmuch as pollen of that age has been identified from the upper

part of the Kirtland Shale. The Telluride Conglomerate of early Eocene age unconformably overlies the volcanics.—*from* Authors' abstract

05071 **Dickson, F. W.** The origin of mercury halos, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 7, Endogenous ore deposits: Prague, Academia, p. 357-365, illus., 1968.

Developed around many ore deposits are halos of anomalously high Hg. According to Russian workers, Hg halos are most intensely developed about Hg deposits, but are also found around Sb, Zn-Pb, and pneumatolytic deposits. Rocks from fault zones have more Hg than rocks outside fault zones. Some Hg is finely dispersed cinnabar, but most is in forms not understood. Some elemental Hg is probably adsorbed on mineral surfaces. Metallic Hg is present in steam of hot-spring systems, but the mode of origin is not well understood. A mechanism for generating and dispersing Hg in natural systems is suggested.—*from* Author's abstract

04868 **Dodd, R. T.** Recrystallized chondrules in the Sharps (H-3) chondrite: Geochim. et Cosmochim. Acta, v. 32, no. 10, p. 1111-1120, illus., tables, 1968.

Microprobe analyses of 50 chondrules in the Sharps (H-3) chondrite showed three to contain essentially homogeneous, calcium-poor olivines. All three show textural evidence of recrystallization, which is subtle in two and pronounced in one. It is concluded that these chondrules were recrystallized before they entered Sharps. Although Sharps is an H-group chondrite, the recrystallized chondrules have olivine and pyroxene compositions appropriate to recrystallized LL-group chondrites. They thus suggest that low-iron material, with a complex previous history, was present at the place of formation of the H-group chondrites.—Author's abstract

04812 **Dodge, F. C. W.; Papike, J. J.; Mays, R. E.** Hornblendes from granitic rocks of the central Sierra Nevada batholith, California: Jour. Petrology, v. 9, no. 3, p. 378-410, illus., 1968.

A detailed study of hornblendes from older, intermediate, and younger granitic rocks indicates that rather than a function of the composition of the host rock, with which only a limited correlation is exhibited, the wide variation in composition of the hornblendes analyzed reflects the effects of regional metamorphism or widespread hydrothermal activity prior to consolidation of the younger rocks. Tabulated data on modal and chemical analyses and norms of the granitic rocks and the chemistry, minor elements, X-ray properties, and structural formulas are included.—MS

05115 **Doe, Bruce R.** Lead and strontium isotopic studies of Cenozoic volcanic rocks in the Rocky Mountain region—A summary, *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 149-174, tables, 1968.

Pb-isotope ratios of basalts from the Rocky Mountain region are within the range of ratios known for silicic igneous sequences in the same region. The upper crust seems an unlikely source for the initial basaltic magma. It is suggested that most of the igneous rocks of the Rocky Mountain region are derived from the lower crust or low-velocity zone in the shallow mantle. The silicic volcanic rocks may then come from large pods of rock of intermediate composition which have a lower melting point than the matrix of basaltic composition. It is suggested that the low values of U/Pb and Th/Pb required for the source by the Pb isotope ratios may be due to a Precambrian age for the dehydration of the lower crust proposed by Ringwood and Green (1966).—KAF

05130 **Doner, H. E.; Pratt, P. F.** Solubility of calcium carbonate precipitated in montmorillonite suspensions: Soil Sci. Soc. America Proc., v. 32, no. 5, p. 743-744, illus., table, 1968.

Calcium carbonate precipitated in Ca- and Mg-saturated montmorillonite suspensions was more soluble than calcite added to these suspensions. The $CaCO_3$ precipitated from a clay suspended in $Ca(OH)_2$ has a greater solubility than when the $CaCO_3$ was precipitated by the addition of $CaCl_2$ and $NaHCO_3$. The difference in solubility between the two directions of approach to equilibrium was related to

the amount of soluble Mg in the system. When $CaCO_3$ was precipitated from $CaCl_2$ and $NaHCO_3$ in clay suspensions with Mg–saturation as a variable, its solubility was related to the amount of Mg in solution with apparently no effect of the clay per se.—Authors' abstract

04690 **Dorf, Erling.** Primeneniye iskopayemykh rasteniy dlya rekonstruktsii paleoklimatov, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow Izdatel'stvo "Mir," p. 16–33, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper on the use of fossil flora for paleoclimate reconstruction presented at the NATO Paleoclimates Conference held in Newcastle–upon–Tyne and Durham, England, on January 7–12, 1963.—DBV

05061 **Downs, Theodore; White, John A.** A vertebrate faunal succession in superposed sediments from Late Pliocene to Middle Pleistocene in California, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 10, Tertiary–Quaternary boundary: Prague, Academia, p. 41–47, illus., 1968.

Mammalian, avian, and reptilian taxa (over 90) have been recovered in one continuous sequence of strata in a portino of the western Colorado Desert of Southern California. The stage of evolution and total known geochronologic range of many of the taxa indicate Late Pliocene to Middle Pleistocene time for the period of deposition of over 8,000 feet of the section. Within the upper 8,000 feet there are rodent and rabbit taxa with well documented "local range zones," some of which overlap. This uninterrupted sequence of faunas or record of "range zones" of taxa and the continuous gradational deposition of sediments in this area reveal no obvious time–stratigraphic or rock–stratigraphic "boundaries", including one between the Tertiary and Quaternary.—*from* Authors' abstract

Drake, Charles H. *See* Crosby, James W., 3d. 04570

Drake, Charles L. *See* Nafe, John E. 04640

04665 **Drake, Charles L.; Nafe, John E.** The transition from oocean to continent from seismic refraction data, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS–NRC Pub. 1687), p. 174–186, illus., 1968.

In an attempt at relating geologic proviinces to seismic character, data on seismic compressional velocities plotted as a function of depth are analyzed and found to vary in a systematic manner. The variations are related to large–scale structures, with least variation in oceanic basins and below low–lying continental shields, and greatest variation in young orogenic belts. Velocities in the range 7.2–7.7 kmps present in some areass, but almost completely absent in oceanic and low–lying continental shields, are interpreted as transient and are considered to appear or disappear with changes in elevation associated with tectonic activity. Continental crust may develop from oceanic crust, but the data do not support the possibility of the reverse process.—MS

Drake, Charles L. *See* Knopoff, Leon. 04674

Duennebier, Frederick K. *See* Johnson, Rockne H. 04673

04611 **Dunbar, Carl O.** Memorial to Lauge Koch (1892–1964): Geol. Soc. America Proc. 1966, p. 267–276, illus., portrait, 1968.

04761 **Durham, David L.** Geology of the Tierra Redonda Mountain and Bradley quadrangles, Monterey and San Luis Obispo Counties, California: U.S. Geol. Survey Bull. 1255, 60 p., illus., tables, geol. maps, 1968.

The map area is in the southern Salinas Valley along the lower reaches of the Nacimiento and San Antonio Rivers. The Jolon fault, which has at least 11 miles of right–lateral displacement, trends northwest across the area and separates unlike stratigraphic sequences. Soulhwest of the fault, unnamed strata of Late Cretaceous and lower Tertiary age are overlain by the Vaqueros, Tierra Redonda, Monterey,

Santa Margarita, and Paso Robles Formations. Northeast of the fault, the pre-Tertiary granitic basement complex is overlain by the Vaqueros, Monterey, Pancho Rico, and Paso Robles Formations. At least 24 unsuccessful exploratory oil wells have been drilled in the area.—DLD

Durham, David L. *See* Smith, Patsy B. 04774

04676 **Durham, J. W.** Iskopayemyye organicheskiye ostatki i nashi svedeniya o nikh, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 379–382, 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7-12, 1963.—DBV

Dutton, Carl E. *See* Tri-State Geological Field Conf. 04793

04772 **Eakins, Gilbert R.** A geochemical investigation of the Wood River-Tikchik Lakes area, southwestern Alaska: Alaska Div. Mines and Minerals Geochem. Rept. 17, 31 p., illus., tables, 1968.

During the summer of 1967 a field party collected 372 stream sediment samples in the Wood River–Tikchik Lakes region to aid in determining the mineral potential. Samples were analyzed for heavy metals by field tests and for copper, lead, zinc, molybdenum, and mercury by the laboratory. Results indicate the mercury analysis is a good geochemical tool for prospecting in the region. Zinc appeared to be the best indicator of the heavy metals group. The most favorable locations for exploration are the following: Marsh Mountain, the south side of the southeast end of Lake Aleknagik, the ridge on the south side of Sunshine Valley, and the ridge on the south side of Little Togiak Lake.—*from* Author's abstract

05044 **Easterbrook, Don J.** Pleistocene stratigraphy of Island County: Washington Dept. Water Resources Water Supply Bull. 25, pt. 1, 34 p., illus., tables, 1968.

The oldest glacial deposits exposed in Island County belong to the Double Bluff; during the following Whidbey Interglacial, floodplain sand, silt, and peat were deposited. Possible correlations are mentioned. An unconformity separates the Whidbey from overlying deposits, in places the Possession Drift but generally the Esperance Sand, deposited by outwash streams. Vashon till mantles most upland areas and the Vashon glacier carved deep troughs in the outwash plain of Esperance Sand. During late phases of the Fraser glaciation, sea level was 100 feet higher than present and floating shelf and berg ice covered parts of the county. Everson glaciomarine drift was deposited on the sea floor from the melting ice. Marine shells from the deposit are dated from 11,850 to 13,010 yr, setting an upper limit for the end of the Vashon.—*from* Author's abstract

05027 **Eberlein, G. Donald; Christ, C. L.** Chemical potential of water from measurements of optic axial angle of zeolites: Science, v. 162, no. 3858, p. 1145-1146, table, 1968.

Values of the uncorrected optic axial angle ($2H\alpha$) of a crystal of the calcium zeolite stellerite ($CaAl_2Si_7O_{18}\cdot 7H_2O$) immersed in calcium chloride solutions of known activity of water (a_w) are directly proportional to log a_w. A general relationship between the chemical potential of water in the crystal and the optic axial angle is obeyed.—Authors' abstract

Edgington, A. N. *See* Sproule, J. C. 05162

04629 **Edmundson, Raymond S.** Memorial to Joseph Kent Roberts (1889–1966): Geol. Soc. America Proc. 1966, p. 363–366, p6ortrait, 1968.

04748 **Egan, W. D.; Achey, F. A.** X-ray fluorescence analysis of a manganese ore, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 150–157, illus., tables, 1968.

X-ray fluorescence has been shown to be a rapid and accurate means of analyzing manganese ore samples. The fast analysis time, one-half hour, was made possible by the application of a sample preparation technique based on pulverization. Pulverization is suitable because there are only slight variations in the mineralogy of the ore samples and because a relatively small particle size can be produced in a short grinding time. Matrix corrections are not required for the X-ray determinations of SiO_2 and CaO in the manganese ore. In the case of manganese and iron, simple matrix correction procedures can be applied manually or with a small digital computer to improve the accuracy of the X-ray determinations significantly.—Authors' conclusions

04578 **Einstein, H. A.** Deposition of suspended particles in a gravel bed: Am. Soc. Civil Engineers Proc., v. 94, paper 6102, Jour. Hydraulics Div., no. HY5, p. 1197–1205, tables, 1968.

The experiments described herein show that the deposition of silt particles moving in suspension over a gravel bed will begin to fill the pores of the gravel from the bottom up leaving the upper layers of gravel relatively clean. The rate at which each size of particle is settled out is proportional to the local concentration. This permits the definition of a half-life T for each particle indicating the time it may stay in suspension until its concentration has been reduced to half the original value by deposition in the gravel bed. The half-life is predicted by an equation while the length of gravel bed in which half the sediment of this particular settling velocity is deposited is T times the flow velocity of the stream in which particles are suspended.—Author's summary

04854 **Elliott, Harold C.** Helena Valley Reservoir investigation, construction, and remedial treatment, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 283–299, illus., 1968.

Cracks in tuff underlying the Helena Valley reservoir were discovered only after it began to leak shortly after filling. The fractures were mapped, showing three systems striking northwest, northeast, and east-west, all steeply dipping. The northwest-striking set cuts the other two, hence is younger. The northwest and northeast sets are sometimes associated with faults and occasionally show displacement. Not all of the fractures are open; some are filled with fine-grained material forming clastic dikes. The filling was from below, and some may have been filled as recently as 1936 from the large earthquake in the region. The open fissures were filled with fine clay material and the water loss in the reservoir is decreasing.—HRC

05159 **Elliott, James E.; Wells, John D.** Anomalous concentrations of gold, silver, and other metals in the Mill Canyon area, Cortez quadrangle, Eureka and Lander Counties, Nevada: U.S. Geol. Survey Circ. 606, 20 p., illus., tables, 1968.

The Mill Canyon area is in the eastern part of the Cortez window of the Roberts Mountains thrust belt in the Cortez quadrangle, north-central Nevada. Gold and silver ores have been mined from fissure veins in Jurassic quartz monzonite and in the bordering Wenban Limestone of Devonian age. Geochemical data show anomalies of gold, silver, lead, zinc, copper, arsenic, antimony, mercury, and tellurium. Geologic and geochemical studies indicate that a formation favorable for gold deposition, the Roberts Mountains Limestone of Silurian age, may be found at depth near the mouth of Mill Canyon.—Authors' abstract

04829 **Ellis, R. M.; Basham, P. W.** Crustal characteristics from short-period P waves: Seismol. Soc. America Bull., v. 58, no. 5, p. 1681–1700, illus., tables, 1968.

Thirty-four teleseismic events, recorded on the deep horizontal sediments of central Alberta, using one fixed and one movable station, have been analyzed as a test of the Haskell matrix formulation applied to short-period P-waves. Only limited agreement is obtained between averaged experimental vertical-horizontal spectral ratio curves and those calculated theoretically using known layer thicknesses and velocities. It is concluded that this region for which the sediments are horizontally layered does not fulfill the requirements of the Haskell matrix theory due to

scattering and anomalous PS conversions in the crust and upper mantle.—*from* Authors' abstract

04617 **Ellison, Samuel P., Jr.** Memorial to Maurice Goldsmith Mehl (1887–1966): Geol. Soc. America Proc. 1966, p. 297–302, portrait, 1968.

05086 **Elsasser, Walter M.** The mechanics of continental drift, *in* Gondwanaland revisited—New evidence for continental drift: Am. Philoos. Soc. Proc., v. 112, no. 5, p. 344–353, illus., 1968.

Evidence is evaluated which indicates that only the upper 700 km of the mantle is involved in the movement which results from convection currents; this would imply that the bulk of the movement is horizontal rather than vertical. This mantle material is heated by radioactive decay, and in an effort to come to equilibrium, tends to rise to the surface at the oceanic rises and to sink in the trench areas. The continents serve as insulating blankets in some areas and because of their density, tend to float, even though being moved by the horizontally-moving material beneath them. They do not sink into the trench areas, hence remain nearby. Two models are described.—HRC

05123 **Elston, Wolfgang E.; Coney, Peter J.; Rhodes, Rodney C.** A progress report on the Mogollon Plateau volcanic province, southwestern New Mexico, *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 261–287, illus., 1968.

The Mogollon Plateau covers about 7,000 sq mi of southwestern New Mexico. Structurally and topographically, it consists of: (1) an outer graben; (2) a mountainous rim, anticlinal in structure; (3) an interior basin, a volcanic-tectonic collapse structure; and (4) a central cone of basaltic andesite. Volcanism, structure, and topography developed over a period lasting 25–30 m.y., with a climax near the Oligocene–Miocene boundary. A negative gravity anomaly of about 30 mgals corresponds to the Mogollon Plateau. Three major ash-flow sequences have been identified. Each sequence contains many cooling units.—*from* Authors' abstract

04859 **Emery, C. L.** Strain in rocks, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 355–364, illus., 1968.

A portable vibration seismograph was used to measure the amplitude and frequency of a vibration induced by blasting. The distance between the blast and seismograph was 100 feet, and the positions of the two were reversed so that the test was made in two directions along a given line. Several points were used around a center. Tracings were made of vertical, longitudinal, and transverse waves, vector particle velocity was calculated for each test. In all cases, the greatest velocity occurred when the wave was traveling from north to south along the 180° azimuth. This is roughly the same direction already determined for the major strains in the region and there appears to be a mathematical basis for assuming that the particle velocity maximizes in the thrust direction. Mathematical models are developed.—HRC

Emery, K. O. *See* Milliman, John D. 04870

04787 **Emiliani, Cesare.** The Pleistocene epoch and the evolution of man [with comments by 24 authors and reply]: Current Anthropology, v. 9, no. 1, p. 27–47, illus., 1968.

In a review article (p. 27–30) Emiliani traces climatic history of the late Cenozoic, synthesizing evidence from stratigraphy, paleontology, paleotemperature curves of deep-sea cores, and absolute-age dating of continental deposits. The objectives are to determine the age of the Plio–Pleistocene boundary at its type locality in Calabria, Italy, to establish worldwide correlation of this boundary, and to work out a chronology of Pleistocene glacial–interglacial cycles. The possible role of paleoclimate in the evolution of man in the Old World is interpreted. Invited comments by 24 authors (p. 30–43) are generally favorable toward the climatic interpretations, but the interpretations are subject to controversy. A general reply

by the author (p. 43–44) and a common reference list (p. 44–47) conclude the paper.—VMJ

Epis, Rudy C. *See* Steven, Thomas A. 05121

Epis, Rudy C. *See* Graebner, Peter. 05124

05127 **Epis, Rudy C.** (editor). Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, 287 p., illus., tables, 1968.

This volume is a direct outgrowth of a symposium on Cenozoic volcanism in the southern Rocky Mountains held at Golden, Colorado, in May, 1967, as part of the 20th annual meeting of the Rocky Mountain Section of the Geological Society of America. Field and petrographic characteristics of Cenozoic volcanic rocks are stressed. New information on the location and nature of eruptive centers within various volcanic piles is presented. Some of these centers are shown to be loci of alteration and mineralization directly connected to post-Laramide volcanic activity. Stratigraphic work has shown that volcanism in the southern Rocky Mountains was particularly prevalent in the Oligocene. Eleven papers and four abstracts are cited separately.—KAF

05129 **Epis, Rudy C.; Chapin, Charles E.** Geologic history of the Thirtynine Mile volcanic field, central Colorado, *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 51–85, illus., 1968.

The Thirtynine Mile volcanic field was built mainly in the Oligocene on a post-Laramide erosion surface, extending from South Park to the Wet Mountain Valley. Volcanic activity began with eruption of an ash flow (40.0±1.4 m.y.) in the vicinity of Thirtynine Mile Mountain. Flows of the lower andesite (34.1±1.1 m.y.) built a volcano centered near Guffey. Following erosion of this volcano, activity shifted to the southern part of the field at Waugh Mountain. During the Miocene, flows of the upper andesite (18.9±1.2 m.y.) erupted in the southern part of the field.—KAF

05167 **Ericson, David B.; Wollin, Goesta.** Pleistocene climates and chronology in deep-sea sediments: Science, v. 162, no. 3859, p. 1227–1234, illus., table, 1968.

The variations in the frequency of the *Globorotalia menardi* complex in 10 cores from the Atlantic and Caribbean suggest a Pleistocene climate of four major glaciations and three interglacial stages. A revised time scale based on magnetic reversals in the cores is proposed, which defines the beginning of the Pleistocene by the first appearance of *Globorotalia truncatulinoides*, about 2 m.y. ago. The Kansan glacial stage now seems to have been longer than the Yarmouth interglacial.—DBV

05137 **Esker, George C., 3d.** Colour markings in *Phacops* and *Greenops* from the Devonian of New York: Palaeontology, v. 11, pt. 4, p. 498–499, illus., 1968.

The colour markings in *Phacops rana* and *Greenops boothi* are described and discussed. It is suggested that *P. rana* had the ability to change its pigmentation. Only four examples of colour markings in trilobites have been mentioned in the literature.—Author's abstract

04763 **Evans, John W.** Growth rate of the rock-boring clam *Penitella penita* (Conrad 1837) in relation to hardness of rock and other factors: Ecology, v. 49, no. 4, p. 619–628, illus., tables, 1968.

In what may be the first study of the growth rate of any rock-boring pholad relative to measured substratum hardness, three populations of *Penitella penita* from intertidal areas at or near Coos Bay, Oreg., were measured for morphology and growth rate. Rocks in all three areas are sandstone with clayey matrix, with relative friability hardness of 1, 2, and 4 respectively. Valves were delicate and elongate in the soft rock, heavy and tumid in the hard rock. Rate of growth, as measured by width of growth bands, decreased as hardness of substratum increased. Evidence from experiments in which animals were replanted in artificial burrows in harder

or softer rock suggests that these differences are not genetically controlled but are induced by relative hardness of the substratum.—VMJ

04847 **Everitt, Martin C.; Runyan, Damon R.** Analysis of the Point Lookout landslide, Mesa Verde National Park, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 117–136, illus., 1968.

The major movement is essentially a low angle planar movement, currently undergoing slow progressive failure. Water probably is the primary problem, in spite of a very small watershed area. The sliding surface is relatively deep and positive corrections of any type could be elaborate and expensive. The other areas not examined in detail in this study, especially those above the road in the vicinity of baseline stations 30+00 to 35+00, represent an earlier stage of this same landslide type and may pose the most serious problem, both short-term and long-term.—*from* Authors' summary

04788 **Evitt, William R.; Wall, David.** Dinoflagellate studies—[Pt.] 4, Theca and cyst of Recent fresh-water *Peridinium lumbatum* (Stokes) Lemmermann: Stanford Univ. Pubs. Geol. Sci., v. 12, no. 2, 15 p., illus., 1968.

Thecae, cysts within thecae, and various stages in cyst development of the living fresh-water dinoflagellate *P. limbatum* from Round Pond, Falmouth, Mass., are described and illustrated by scanning electron micrographs; comparison with *P. limbatum minnesotense* Eisenack (1965 from postglacial sediments of Weber Lake, Minn.) suggests that the "subspecies" is a cyst, probably of typical *P. limbatum*. The capsulate cyst of the extant species is considered homologous with Mesozoic and Tertiary dinoflagellates known as *Deflandrea*—new evidence that these fossil forms are cysts and not thecae. *P. limbatum* and *D. phosphoritica* Eisenack 1938 have distinctive archeopyles, despite general affinities of the cysts, and may represent distinct peridinioid lineages.—VMJ

04669 **Ewing, John; Ewing, Maurice; Aitken, Thomas; Ludwig, William J.** North Pacific sediment layers measured by seismic profiling, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 147–173, illus., 1968.

Seismic data support the conclusion that most pre-Tertiary sediments of the north Pacific basin are in the western part of the basin and that the pattern of distribution of Cenozoic sediments can best be explained in terms of the concept of discontinuous sea-floor spreading during the past 10–12 million years. The pattern of accumulation of the sediments exhibits striking similarities to the present-day pattern of biological activity.—MS

04681 **Ewing, M.** Otrazheniye lednikovykh i mezhlednikovykh epokh v glubokovodnykh osadkakh, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izda el'stvo "Mir," p. 216–220, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

Ewing, Maurice. *See* Ewing, John. 04669

Fabbi, B. P. *See* Volborth, A. 04749

04781 **Fader, Stuart W.** Ground water in the Republican River area, Cloud, Jewell, and Republic Counties, Kansas: Kansas Geol. Survey Bull. 188, 27 p., illus., tables, 1968.

Both surface and ground water are used for irrigation in the Republican River area; the combination of surface-water irrigation and recharge from precipitation has caused high ground-water levels in some upland areas. In the lowland, alluvial deposits yield as much as 1,400 gpm to wells, and about 12,300 acre-feet of ground

water is pumped annually for irrigation and other uses. It is estimated that 710 acre-feet was removed from the Republican River in 1963 by pumping of ground water. Coefficients of transmissibility from 61 well sites were used in making the estimate. Ground-water recharge from precipitation was estimated to be 0.6 in. and ground-water losses to evapotranspiration to be less than 0.2 in. Chlorides in ground water in northern Cloud County are tabulated and the areas mapped where the ground water might be unfit for irrigation use.—*from* Author's abstract

04685 **Fairbridge, R. W.** Znacheniye izvestnyakov i ikh Ca/Mg otnosheniya dlya paleoklimatologii, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 258–309, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

04836 **Fairbridge, Rhodes W.; Newman, Walter S.** Postglacial crustal subsidence of the New York area [with German and French abs.]: Zeitschr. Geomorphologie, v. 12, no. 3, p. 296–317, illus., tables, 1968.

Various lines of evidence indicate that the southern coast of New England has been subsiding since middle Holocene time. Tidal records from 1900 to 1950 suggest a crustal subsidence of 1.0 to 2.0 mm per yr after application of eustatic corrections. Geodetic leveling between the Canadian border and Perth Amboy, N. J., indicates that the area of Greater New York is subsiding from 1.4 to 2.8 mm per yr. Locations of archaeologic sites, drowned forests, and peat suggest that subsidence near New York has been continuous, has diminished toward southern New England, and has varied locally for the last 7,000 yr; postglacial uplift of the New England coast ceased progressively from south to north between 9,000 to 3,000 years ago. Accumulation of sediments in the geosyncline of the east coast north of Cape Hatteras, N.C., can account for this subsidence.—VSN

Fanning, D. S. *See* Tapper, M. 04742

Farquhar, R. M. *See* Hamilton, E. I. 04564

Farrell, Donald F. *See* Norvitch, Ralph F. 04760

Fenton, Robert L. *See* Crosby, James W., 3d. 04570

04745 **Fertl, Walter; Jessen, F. W.** Cation equilibria studies on fractionated natural clays [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 4, p. 313–318, illus., tables, 1968.

Various fractions, ranging in size from 5 to 0.05μ of natural clays from Mexico and Wyoming, occurring as heterogeneous or multicomponent cationic systems, were studied under specific equilibrium conditions of salt concentrations in the range found in many drilling fluids and formation waters. Glass electrodes were utilized in this study. A Tektite electrode was found to have specific sensitivity to divalent cations.—Authors' abstract

05097 **Fielder, G.; Guest, J. E.** Size-frequency distributions of particles and lunar surface materials: Earth and Planetary Sci. Letters, v. 5, no. 2, p. 86–88, illus., table, 1968.

Cumulative plots of particle sizes of (a) two samples of the lunar surface photographed by *Surveyor* craft, (b) throwout fragments from ballistic cratering events, (c) four samples of ignimbrites, are shown to have essentially the same slope. Using the present data it is not possible to distinguish between areas which have reached their present state by impact fragmentation of the surface rocks or by deposition of pyroclastic rocks.—Authors' abstract

04660 **Finlayson, J. Bruce; Barnes, I. Lynus; Naughton, John J.** Developments in volcanic gas research in Hawaii, *in* The crust and upper mantle of the Pacific area—

Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 428–438, illus., tables, 1968.

Gases have been collected from the surface of a Hawaiian lava lake during recent eruptions, and from holes drilled through the solid crusts of these lakes. The gases and accompanying sublimates have been analyzed by a variety of techniques, and changes in gaseous composition during the cooling and solidification of the lava lake have been followed. A progressive depletion of carbon and sulfur gases with time is noted. These changes seem to be associated with the relative solubilities of the gaseous components in the rock melt. Reasons for the variability in sample composition were investigated, and the relationship of the sample collected to primary magmatic gases is discussed.—Authors' abstract

Finn, James J. *See* Kramer, Henry H. 04706

04675 **Fischer, A. G.** Opresneniye okeanov kak prichina vymiraniya morskoy fauny na rubezhe permi i triasa, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 362–370, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7-12, 1963.—DBV

04678 **Fischer, A. G.** Kharakter rosta siluriyskikh tabulyat kak paleoklimatologicheskiy i paleogeograficheskiy priznak, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 393–401, illus., table, 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7-12, 1963.—DBV

04773 **Fischer, R. P.; Luedke, R. G.; Sheridan, M. J.; Raabe, R. G.** Mineral resources of the Uncompahgre primitive area, Colorado: U.S. Geol. Survey Bull. 1261-C, p. C1–C91, illus., tables, geol. map, 1968.

The Uncompahgre primitive area, Colorado, covers about 130 square miles and partly overlaps an area of intensive mining in the northwestern San Juan Mountains. Since the 1870's, mines in the primitive area and a border zone about 1 1/2 miles wide around it have yielded about 332 million dollars worth of minerals, mostly gold, silver, copper, lead, and zinc. In 1965, mines in and near the primitive area yielded nearly 9 1/2 million dollars worth of these metals. Ore reserves total about 8 1/2 million tons, which, at the current rate of mining, represents about a 10-year supply of ore. The resource potential for these metals is probably several times larger.—RPF

04598 **Fisher, D. Jerome.** Memorial to Albert Dudley Brokaw (1880–1966): Geol. Soc. America Proc. 1966, p. 187–189, portrait, 1968.

Fisher, David E. *See* Funkhouser, John G. 05098

04709 **Fleischer, Robert L.; Price, P. Buford; Walker, Robert M.** Charged particle tracks—Tools for geochronology and meteorite studies *in* Radiometric dating for geologists (E. I. Hamilton and R. M. Farquhar, editors): London and New York, Interscience Publishers, p. 417–435, illus., 1968.

Etched tracks in natural crystals give a promising new method of dating terrestrial samples and of measuring uranium and thorium distributions. In extraterrestrial samples, they are being used to study the relative abundance of extremely heavy cosmic rays as well as the early history of the solar system.—Authors' abstrace

04722 **Flint, Richard Foster.** The surficial geology of the Ansonia and Milford quadrangles, with map: Connecticut Geol. and Nat. History Survey Quad. Rept. 23, 36 p., illus., geol. maps, 1968.

In this till covered, eastern part of the Western Highlands of Connecticut, features of glacial erosion include striations, grooves, stoss-and-lee knobs, and streamline hills. There appear to have been two successive ice movements, one toward the south, the other southwest. Stratified drift in many low parts comprises seven bodies, mostly of valley-train character, coalescent in places; two have small areas of associated lacustrine sediments. An irregular ice front for latest deglaciation is indicated. As valley trains were built up, wind blew their sand and silt thinly over adjacent areas; streams during postglacial dissection spread thin bands of alluvium on valley floors. Swamp and marsh deposits accumulated in many shallow basins in bedrock and glacial drift; tidal marshes are a result of postglacial rise in sea level. Ground water, sand and gravel, till and humus have potential economic value.—GDC

04661 **Folinsbee, R. E.; Baadsgaard, H.; Cumming, G. L.; Green, D. C.** A very ancient island arc, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 441–448, illus., tables, 1968.

Mafic volcanic rocks in the Archean of the Yellowknife area, Northwest Territories, characterized by well-developed pillows in many of the basalt flows, represent extrusive activity, dated as 2625 (2480) m.y. old, in an island arc environment similar to the fossa magna of Japan. Duration of the period of volcanism and subsequent intrusive activity, followed by graywacke sedimentation, was of the same order of magnitude (some 15 m.y.) as that involved in processes of Miocene extrusion, intrusion, and burial in the Japanese area.—MS

04705 **Forbes, Lynn.** (compiler). Oceanography in print—A selected list of educational resources: Falmouth, Mass., Falmouth Public Schools, 58 p., 1968.

This bibliography was compiled in cooperation with Woods Hole Oceanographic Institution and the Marine Biological Laboratory as a guide to students, educators, librarians, and the general reader of oceanography. Books are categorized according to age group for which they were written, and each category is subdivided into: general oceanography, marine biology, physical oceanography, marine geology, chemical oceanography, and marine meteorology. For the adult category, books are classified as technical or for general reading. Periodicals are grouped into: magazines, scientific and technical journals, and articles in *National Geographic* and *Scientific American*. Films and filmstrips with distributors' addresses are listed. "Miscellaneous material" contains maps, catalogs and bibliographies, and a study kit. An author index is included.—MCM

04792 **Fowler, R. A.** Earthquake prediction from laser surveying—A report, NASA SP-5042: Washington, D. C., Natl. Aeronautics and Space Adm., 32 p., illus., tables, 1968.

The Geodetic Laser Survey System, described in this report, overcomes the constraints in existing systems. It has been found that the measured strain across a fault zone is probably the most useful earthquake prediction parameter, and the sensitivity of this system's instrumentation permits identification of small strain rates over short time periods. Preparation of seismic probability maps using information from early-warning networks is discussed, and the LACE program aimed at determination of atmospheric effects on laser propagation is described. A chapter devoted to precise measurement of long distances discusses mainly passive vs. active systems and the limitations of existing systems. Both experimental and improved Geodetic Laser Survey Systems are described.—ESL

04842 **Fox, Richard C.** Studies of Late Cretaceous vertebrates—[Pt.] 2, Generic diversity among multituberculates [discussion of paper by L. VanValen and R. E. Sloan, 1966]: Systematic Zoology, v. 17, no. 3, p. 339–342, 1968.

Fox points out limitations of the data used by VanValen and Sloan [ibid., v. 15, no. 4, p. 261–278, 1966] to postulate increased generic diversification of multituberculates during Late Cretaceous and Paleocene time in western North America. It is practically certain that: (1) death assemblages so far sampled from Campanian and Maestrichtian continental rocks represent only a fraction of the

multituberculates that lived in the floodplains and none of those that must have lived in bordering uplands; (2) collecting of multituberculates has not yet been sufficiently widespread to permit any confident assessment of generic diversity among them or of facies differences in the preserved floodplain assemblages.—VMJ

05000 **Francheteau, Jean; Sclater, J. G.; Richards, M. L.; Harrison, C. G. A.** Comments on paper by G. R. Schimke and C. G. Bufe, "Geophysical description of a Pacific Ocean seamount" [1968]: Jour. Geophys. Research, v. 73, no. 24, p. 7713–7715, illus., 1968.

The validity of the magnetic interpretation of Schimke and Bufe (ibid., v. 73, no. 2, p. 559–569, 1968) is questioned. There is an inconsistency between the proposed age of the Chautauqua seamount (Matuyama polarity epoch) and the direction of its magnetization vector. If it is Cretaceous, as suggested as a possible alternative age, then the scatter in paleomagnetic data for that period does not rule out polar wandering as an explanation. All inconsistency can be removed if the major portion of Chautauqua seamount was formed near lat 7°S. during a reversed epoch. The evidence strongly suggests that the seamount might be late Cretaceous and not at all related to recent volcanism in the Hawaiian Islands.—DBV

Frazier, G. A. *See* Keightley, W. O. 04850

Friend, Joseph E. *See* Sanford, John T. 04719

04795 **Frisch, Bruce.** The case of the drifting continents: Petroleum Today, v. 9, no. 4, p. 30–33, illus., 1968.

This is a popular account of the continental drift controversy, its history, geologic evidence on continents and islands, and the present drilling program on the ocean floor.—ESL

04839 **Frye, John C.; Willman, H. B.; Rubin, Meyer; Black, Robert F.** Definition of Wisconsinan Stage: U.S. Geol. Survey Bull. 1274–E, p. E1–E22, illus., 1968.

The Wisconsinan Stage of the Pleistocene is described and defined as a time stratigraphic unit for use in Illinois and Wisconsin. The Wisconsinan includes all deposits from the contact of the Roxana Silt on the A-horizon of the Sangamon soil at the base to the top of the Cochrane till and its contact with the overlying post-Cochrane deposits in the James Bay Lowland of Ontario, Canada. The substages of the Wisconsinan Stage also are described and defined; these are (from the base upward) the Altonian, Farmdalian, Woodfordian, Twocreekan, and Valderan. Correlations from type areas throughout this region are based on physical stratigraphy, abundant radiocarbon age determinations, and paleontology.—Authors' abstract

05098 **Funkhouser, John G.; Fisher, David E.; Bonatti, Enrico.** Excess argon in deep-sea rocks Earth and Planetary Sci. Letters, v. 5, no. 2, p. 95–100, illus., table, 1968.

Excess radiogenic argon and helium were found in fresh, geologically young submarine basalts dredged from the crest of the East Pacific Rise and from several seamounts at varying distances from the crest. The presence of excess gases is related to the glass content of the samples; the glassy outer rim retaining the greatest amount, the more crystalline interior of the flow showing less or no excess radiogenic gas. No definite criteria, other than the glass content, could be established to judge the validity of measured K–Ar ages, although fission-track measurements on a limited number of samples provided reasonable upper limits.—Authors' abstract

04666 **Furumoto, Augustine S.; Woollard, George P.; Campbell, J. F.; Hussong, D. M.** Variation in the thickness of the crust in the Hawaiian archipelago, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 94–111, illus., tables, 1968.

During 1965 and 1966, a series of seismic refraction surveys were made over the Hawaiian arch, trench, and ridge, and in the area to the south of the ridge. The crust thickens from about 5.0 to 20 km from the arch toward the ridge; about 300 km south of the ridge, it was found to be 9.5 km thick, which is thicker than would be expected for the depth of water (4.5 km). By combining present results with earlier data obtained by other investigators, it was found: that the arch and trench show consistent values of crustal thickness (about 5.0 km) from north of Kauai to north of Maui; that the crust under the islands varies between 12 and 20 km in thickness and is complicated by intrusive bodies of very high seismic velocity; and that there are marked differences in crustal thickness to the north and south of the ridge.—*from* Authors' abstract

04667 **Furumoto, Augustine S.; Adams, William Mansfield.** Seismic refraction study of the internal structure of a volcanic cinder cone, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 112–121, illus., 1968.

The summit cone of Mauna Kea volcano, Hawaii, was probed by seismic methods in a search for possible solid layers on which an astronomical observatory could be constructed. The method of aplanatic surfaces was used to analyze and interpret the data, as conventional refraction traveltime curves were inconclusive. Three zones were detected in the interior of the summit cone, but none of the zones showed seismic velocities high enough to suggest solid material. This seismic survey perhaps holds the world's record for high altitude in seismic traverses.—Authors' abstract

Furuta, T. *See* Rhodes, J. R. 04758

04992 **Gabelman, John W.** Metallotectonic zoning in the North American Appalachian region, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 7, Endogenous ore deposits: Prague, Academia, p. 17–33, illus., 1968.

Plotting dominant metals of districts and occurrences in the U.S. and Canadian Appalachians suggests a series of regional metal zones parallel to the tectonic grain and arranged in paragenetic sequence and decreasing intensity westward across the Appalachians from the Piedmont. The localization of many mineralization centers along the eastern margin of the Blue Ridge and the Brevard fault suggests a preferential control by these structures. Age differences within a single tectonic cycle do not reduce the clarity of regional zoning. However, mineralization patterns related to different tectonic cycles are recognizable.—*from* Author's abstract

05062 **Gabunia, L.; Rubinstein, M.** On the correlation of the Cenozoic deposits of Eurasia and North America based on the fossil mammals and absolute age data, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 10, Tertiary-Quaternary boundary: Prague, Academia, p. 9–17, illus., 1968.

A discussion of the fossil mammalian faunas and absolute age data of the Upper Cretaceous and Cenozoic deposits of Eurasia and North America leads to a new correlation scheme of these deposits based on the European subdivision of the Cenozoic. The scheme of correlation is constructed in the form of a timescale based on 122 stratigraphically well-dated points. The absolute age data of correlated deposits indicate that at least the lower part of the Danian stage of Eurasia corresponds to the upper part of the "Maastrichtian" of North America, as well as the upper Miocene of Eurasia to the lower Pliocene of North America. These data indicate that the extinction of principal Dinosaurian groups occurred during a time of no less than 10 m.y.—*from* Authors' abstract

05105 **Gager, H. M.** Mössbauer spectra of deep-sea iron-manganese nodules: Nature, v. 220, no. 5171, p. 1021–1023, illus., tables, 1968.

The Mössbauer spectra of nodules from the Atlantic Blake Plateau and from two mid-equatorial Pacific Ocean locations were investigated. When recovered the nodules are nonmagnetic, but they become magnetic upon heating. The roasted nodules from different locations have the same basic structural units with varying proportions of Fe and Mn occupying the spinel lattice sites. The Mössbauer spectra of the unheated nodules also indicate that the iron in the nodules from different

locations is bound in similar fashion. The spectra are consistent with the presence of lepidocrocite or goethite in a finely divided state; however, the exact composition of the iron matrix of the unheated nodules is still in question.—DBV

04584 **Galbraith, Frank W.; Schreiner, Robert N.** Shock spectra from subsurface nuclear explosions: Am. Soc. Civil Engineers Proc., v. 94, paper 6140, Jour. Eng. Mechanics Div., no. EM5, p. 1015–1027, illus., tables, 1968.

Equations are given for computing vertical and horizontal radial ground-shock spectra from an underground nuclear explosion. Parameters required are the yield of the explosion, the slant range from the explosion, and the seismic velocity and density of the geologic medium. The equations are based on shock spectra measured from 15 nuclear explosions in four media ranging from alluvium to granite. The reed gages used in the measurements and their field installation are described. A subsequent subsurface nuclear explosion provided an opportunity for evaluating the application of the equations. The computed shock spectra are compared with the measured values; good correlation is shown to exist.—Authors' abstract

04858 **Galster, Richard W.** Engineering geology at the Flathead Tunnel, Libby Project, Montana, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 347–354, illus., 1968.

Flathead Tunnel is being driven through metasedimentary rocks of the Precambrian Belt Series. Joints, consisting of bedding joints, complementary joints with similar strike but dipping normal to the bedding, two conjugate sets of shear joints, and a set of relaxation joints are present, along with several major faults. Among structural features are the Elk Mountain anticline and fault zone, Grey Creek fault, Twin Meadows fault zone, the Davis Creek structural surprise (a fold not encountered in surface investigation), and the Burrows Creek fault (the cause of the Burrows Creek slide). Each feature is discussed in terms of how the engineers solved the problems resulting from them.—HRC

Gamble, E. E. *See* Daniels, R. B. 04985

05090 **Ganguly, J.; Newton, R. C.** Thermal stability of chloritoid at high pressure and relatively high oxygen fugacity: Jour. Petrology, v. 9, no. 3, p. 444–466, illus., 1968.

Experimental investigations of the chloritoid breakdown involving magnetite, under conditions of controlled oxygen fugacity at high total pressure, gave a value of approximately 550°C for the oxidation reaction of chloritoid to staurolite, magnetite, quartz, and vapor in the pressure range 5–10 kb, considered equivalent to probable pressures of deep-seated metamorphism. The experimental procedures and results are described in detail.—MS

04777 **Garrett, A. A.** Ground-water withdrawal in the Odessa area, Adams, Grant, and Lincoln Counties, Washington: Washington Dept. Water Resources Water-Supply Bull. 31, 84 p., illus., tables, 1968.

Since 1960 irrigation of wheat with ground water in the Odessa area has been common and withdrawals have increased greatly. Supplies are being developed nonuniformly, resulting in decline of ground-water levels in some areas. Most wells are pumped nearly continuously during 7 months of the year and are idle during the other five; some wells are not idle long enough for water levels to recover completely before the next pumping season begins. In many sections, water levels in shallow aquifers are different in altitude from those in deeper aquifers tapped by many large-yield irrigation wells. Nonetheless, pumping of some of the deeper irrigation wells produces water-level declines in shallow wells. Simultaneous pumping of several wells has resulted in declines of as much as a foot in shallow wells as far as three miles distant.—*from* Author's abstract

Gast, P. W. *See* Hills, F. Allan. 05055

04866 **Gast, Paul W.** Trace element fractionation and the origin of tholeiitic and alkaline magma types: Geochim. et Cosmochim. Acta, v. 32, no. 10, p. 1057–1086, illus., table, 1968.

Oceanic volcanic rocks can roughly be divided into two major chemical types: (1) tholeiitic or abyssal basalts and (2) alkaline or undersaturated basalts. Trace element abundances in these two types are compared. It is shown that the high abundance of large ion elements in alkaline basalts cannot be consistently explained by fractional crystallization processes. Both the absolute abundance and relative abundance of many large ion elements in alkaline magmas are entirely consistent with the hypothesis that these liquids are produced by partial melting (3–7 percent) of accepted upper mantle mineral assemblages. It is postulated that the high K/Rb and low Ba/Sr and La/Yb ratios in abyssal basalts are characteristics of the upper mantle region that produced these basalts and that these characteristics are produced by previous partial melting episodes.—Author's abstract

Gedney, Larry. *See* Hanson, Kenneth. 04827

Geitgey, Ronald P. *See* Mitchell, Richard S. 04890

George, J. D. *See* Baker, T. W. 04755

04862 **Geoscience Information Society.** (Guidebook and Ephemeral Materials Committee). Geologic field trip guidebooks of North America—A union list incorporating monographic titles, 1968 edition: Houston, Tex., Phil Wilson, Publisher, 97 p., 1968.

Introductory information includes a directory of the 23 participating libraries, indicating lending policy, copying service, and use of material on premises, and fictitious sample entries with a plan of the volume. In the union list, societies appear alphabetically with a chronological list of titles of individual guidebooks. Cross references indicate variations in cataloging and entries of participating groups. A location index for organizations is appended for the United States (by state), Canada (by province), Mexico, Cuba, Guatemala, and Puerto Rico. The earliest entries are those for the 5th International Geological Congress, 1891.—MCM

04882 **Geyne, Arturo R.** Guides for the interpretation of barren and weak surface expression of buried orebodies in the Pachuca–Real del Monte district, Mexico [abs.]: Econ. Geology, v. 63, no. 6, p. 702, 1968.

Gibbon, D. L. *See* Brindley, G. W. 04876

05134 **Giberson, Melbourne F.** Maximum response ranges of nonlinear multi-story structures subjected to earthquakes: Seismol. Soc. America Bull., v. 58, no. 5, p. 1639–1655, illus., tables, 1968.

The earthquake responses of a twenty-story nonlinear structural frame were calculated. The structure was modeled by a two-dimensional frame with girders and columns having bilinear binding moment-end rotation hysteretic characteristics. In addition to hysteretic damping, viscous damping mechanisms were assumed. Earthquakes used were the El Centro (N–S) of May 18, 1940 and several pseudo-earthquakes. Certain behavior characteristics of the structural responses were identified which appeared to be determined more by the properties of the structure than by the earthquake. For the series of pseudo-earthquakes used, a large range was found in the maximum values of the responses of the yielding structure. Statistics of the magnitudes of the displacements and ductility factors were compared with three common measurements of the strength of earthquake accelerograms; none of these measurements correlated well with the trend of maximum responses.—*from* Author's abstract

04821 **Gile, L. H.; Hawley, J. W.** Age and comparative development of desert soils at the Gardner Spring radiocarbon site, New Mexico: Soil Sci. Soc. America Proc., v. 32, no. 5, p. 709–716, illus., tables, 1968.

Radiocarbon ages were obtained from seven buried charcoal horizons in a desert area [along the San Andres Mts.]. With increasing age of soil during Recent time, the progression of soil development appears to have been marked by development of an A horizon, destruction of thin sedimentary strata, slight accumulation of carbonate, development of structure in materials of sufficiently fine texture, and,

with continued carbonate accumulation, development of a weak calcic horizon. Soils of Pleistocene age can have distinct argillic horizons and strong horizons of carbonate accumulation.—Editor's abstract

05082 **Gile, L. H.; Grossman, R. B.** Morphology of the argillic horizon in desert soils of southern New Mexico: Soil Sci., v. 106, no. 1, p. 6–15, illus., tables, 1968.

Morphology of the argillic horizon in southern New Mexico is affected by the amount of authigenic carbonate, the amount of clay, and the proportion of coarse material. Prominent argillic horizons formed primarily during the Pleistocene and are largely relict. Clay skins are an important marker of the argillic horiizon. Preservation of clay skins requires restricted physical disturbance. Clay coating on pebbles and sand grains may be disrupted by carbonate. Strong carbonate accumulation has obliterated oriented clay coatings in parts of some argillic horizons.—JWH

04710 **Giletti, Bruno J.** Isotopic geochronology of Montana and Wyoming, *in* Radiometric dating for geologists (E. I. Hamilton and R. M. Farquhar, editors): London and New York, Interscience Publishers, p. 111–146, illus., tables, 1968.

The ranges of Montana and Wyoming display a long geologic history, followed here with the aid of K–Ar, Rb–Sr, and zircon isotopic U–Pb age measurements. The oldest values fall at about 3200 to 3000 m.y. ago, with other terranes yielding ages around 2600 m.y., 1900 m.y., 1600 m.y., and younger. The deposition of the Belt Series began after 1600 m.y. ago and was completed 1200 m.y. ago. The ages are interpreted in terms of continental accretion and metamorphic events.—HF

05038 **Godson, Richard H.; Watkins, Joel S.** Seismic resonance investigation of a near-surface cavity in Anchor Reservoir, Wyoming: Assoc. Eng. Geologists Bull., v. 5, no. 1, p. 27–36, illus., 1968.

Since the first attempt to fill this reservoir, numerous sinks have developed and prevented the filling. The good correlation between gravity anomaly and seismic resonance distribution suggests that a subsurface cavity is present in this area. The presence of a surface crack and an inferred fault in conjunction with the inferred cavity further suggests that the formation of the underground void is associated with a fault-zone.—Authors' conclusions

05110 **Goldie, L. F. E.** The exploitability test—Interpretation and potentialities: Nat. Resources Jour., v. 8, no. 3, p. 434–477, illus., tables, 1968.

Recently the United States Government has granted leases to blocks of oil and gas lands extending beyond the 200 metre, or 100 fathom (600 foot) bathymetric contour line outside its territorial waters, purportedly under authority vested by the Outer Continental Shelf Lands Act of 1953. The validity, according to the 1958 Continental Shelf Convention enacted in 1964, of the 600-foot depth limit shown on maps of Pacific shelf areas is internationally questioned. As undersea technology and States' maritime ambitions and greed develop, an "enclosure movement" by threatened use of the exploitability test which could swallow up vast reaches of the high sea, depending upon a strict or liberal interpretation of the seabed and subsoil of these submarine areas adjacent to the coast, might be avoided by a transnational treaty regime spelling out procedures for allocation of mineral rights over specified marine areas.—GDC

Goodman, C. D. *See* Lafleur, L. D. 05151

Goodman, R. E. *See* Mahtab, M. A. 04800

04715 **Goodwin, A. M.** Evolution of the Canadian Shield: Geol. Assoc. Canada Proc., v. 19, p. 1–14, illus., table, 1968.

Precambrian crustal development as exhibited by the Canadian Shield is summarized. Trends were from thin-crustal, unstable protocontinents to a thick, stable continent representing the pre-geosynclinal and early geosynclinal stages of development. Sites of supracrustal accumulation progressed from random sub-lineal

Archean basins and trenches to long, continuous Proterozoic troughs, stable platforms, and primitive geosynclines. From Archean to Proterozoic, preferred easterly and northerly trends changed to northeasterly and northwesterly trends, immature flysch-type sedimentation to mature shelf-type sedimentation, volcanic activity from calc-alkaline and sequential to chemically diverse and non-sequential, and simple and experimental organic activity to simple and established organic activity. A major increase within the crust of the main radioactive heat-producing elements had profound consequences.—*from* Author's conclusion

05066 **Goodwin, A. M.** Archean protocontinental growth and early crustal history of the Canadian Shield, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 1, Upper mantle (geological processes): Prague, Academia, p. 69–89, illus., tables, 1968.

Archean crustal history was dominated by growth and aggregation of discrete protocontinents. Remants of four protocontinents are recognized in the Canadian Shield. The protocontinents exhibit random to sublinear basin distribution patterns, the product of an unstable pre-geosynclinal stage of crustal development. Protocontinental growth, aggregation, and consolidation produced a single cratonic mass which dominated ensuing Proterozoic history. Attainment of crustal stability by this means led to stable platforms and primitive geosynclines. Platform stability is recorded in the characteristic Proterozoic lithologic assemblage which includes pure quartzite, dolomite, and Lake Superior-type iron formation. The record of the Canadian Shield points to a continuum of crustal evolution in the direction of a larger, thicker, more stable crustal mass.—*from* Author's abstract

05078 **Gore, Dorothy J.** Potash metasomatism and granitization accomplished by boron-potassium compounds, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 4, Geology of Precambrian: Prague, Academia, p. 275–292, illus., tables, 1968.

Worldwide occurrence of rocks, rich in potassic feldspar and similar in mineralogy, texture, and chemistry, has been interpreted as originating by replacement in which potash metasomatism has played a major role. This study is concerned with the potash rich rocks in Wisconsin, along the southern margin of the exposed part of the Canadian Shield. The individual granite bodies are only a few sq km in outcrop area and are marginal to large plutonic complexes. Indicators of potash mobility and metasomatism are discussed. It is concluded: (1) that potash metasomatism occurred under high temperature and shearing stress; (2) that potash metasomatism is most conspicuous where shearing and crushing of the rock is pronounced; (3) that the source of potash responsible for the metasomatism is largely from minerals in rocks at no great distance from the site of replacement.—*from* Author's abstract

05124 **Graebner, Peter; Epis, Rudy C.** Remanent magnetism in major rock units of the Thirtynine Mile volcanic field, central Colorado [abs.], *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 87–88, 1968.

Graf, Walter E. *See* Acaroglu, Ertan R. 05103

Gray, Fenton. *See* Culver, James R. 05140

Green, D. C. *See* Folinsbee, R. E. 04661

04648 **Green, D. H.** Origin of basaltic magmas, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 2 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 835–862, tables, 1968.

Basaltic magmas are considered to be derived by partial melting within a mantle of peridotitic composition. There is evidence for inhomogeneity in this mantle composition, particularly in those elements that do not substitute readily in the major minerals (olivine, enstatite, clinopyroxene, spinel, garnet). On the other hand, the major oxides of basaltic magmas, which determine the basalt type as defined on a modal or normative basis, probably vary in response to variations in conditions of melting (pressure, temperature) or degree of melting.—*from* Author's conclusion

04822 **Greensfelder, Roger.** Aftershocks of the Truckee, California, earthquake of September 12, 1966: Seismol. Soc. America Bull., v. 58, no. 5, p. 1607–1620, illus., tables, 1968.

On September 12, 1966, at 16h 41m, an earthquake of magnitude 6.0 to 6.5 occurred about 10 km northeast of Truckee, California. Hypocenters of 158 aftershocks that occurred between September 14 and 25 were found to be within a volume 3 km wide by 10 km long by 12 km deep. The magnitude–frequency curve appears anomalous, as there seem to be too many shocks greater than magnitude 2 compared to the number of small ones under magnitude 0.5. Nodal-plane determinations indicate two modes of faulting for the aftershocks. Strike-slip faulting with nodal planes striking N. 40°W. and N. 50°E. is dominant; secondary normal faulting occurs on nodal planes striking nearly north. An attempt is made to relate the strain release pattern of these aftershocks to major regional right-lateral shear and extension.—Author's abstract

Greenwood, William R. *See* Reid, Rolland R. 05074

Grierson, J. D. *See* Banks, H. P. 05114

04980 **Groenewoud, H. van.** Methods and apparatus for measuring air permeability of the soil: Soil Sci., v. 106, no. 4, p. 275–279, illus., tables, 1968.

A number of methods for measuring air permeability have been described by both forest and agriculture soil workers. Several of these methods were tested for use in forest soils by the author, but none was found to be entirely satisfactory. This paper describes a modified method and equipment developed by the author.—JWH

Grossman, R. B. *See* Gile, L. H. 05082

Guber, Albert L. *See* Cohen, Arthur D. 05014

Guest, J. E. *See* Fielder, G. 05097

05166 **Habib, Daniel.** Spores, pollen and microplankton from the horizon beta outcrop: Science, v. 162, no. 3861, p. 1480–1481, illus., table, 1968.

Palynology was used for dating a pre-Pleistocene deep-sea organic lutite layer situated stratigraphically near seismic horizon beta, below horizon A. The spores and pollen are closely identified, quantitatively, with nonmarine and marine Middle Cretaceous assemblages (Albian–Cenomanian) on the continents, an age designation that is confirmed by the occurrence of dinoflagellate cysts, acritarchs, foraminifers, and coccoliths in the investigated cores. The abundance of these well-preserved, land-derived assemblages in an area far removed from a source suggests some tectonic displacement since their deposition.—Author's abstract

04753 **Hach, J. T.; White, E. W.** Study of extended X-ray absorption fine structure with the use of thick targets, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 339–344, illus., 1968.

The method takes advantage of the absorption of continuum X-rays that emerge at low takeoff angles from an electron bombarded target. The extended fine structure is observed as undulations in the continuum X-ray intensity in the region of the self-absorption edge. Spectra obtained by this method are compared with published data. For iron and copper targets, the best contrast is obtained when using a 50-kV accelerating voltage; a takeoff angle of 3° yielded best results for copper, while an angle of 10° was best suited for iron. The Philibert absorption correction used in electron microprobe analysis has been extended to account for the observed self-absorption effect. The primary advantage of the thick-target technique is the ability to obtain absorption spectra without preparing thin films.—*from* Authors' abstract

04806 **Halberg, H. N.; Bryant, C. T.; Hines, M. S.** Water resources of Grant and Hot Spring Counties, Arkansas: U.S. Geol. Survey Water-Supply Paper 1857, 64 p., illus., tables, geol. map, 1968.

In Grant and Hot Spring Counties, the Ouachita, Saline, and Caddo Rivers yield large quantities of soft good-quality water. The Sparta Sand, the principal aquifer, yields as much as 850 gpm of soft water in Grant County. The Carrizo Sand and Cane River Formation are potentially important aquifers in Grant County and southeastern Hot Spring County. The Wilcox Group yields as much as 300 gpm of fresh water in southeastern Hot Spring County and southwestern Grant County; in the rest of Grant County its water is brackish. The alluvium along the principal streams and the consolidated rocks of the Ouachita Mountains yield small quantities of water that vary in quality from place to place. Some of the water from the alluvium has high nitrate content and may be a hazard to health.—*from* Authors' abstract

04856 **Hall, Charles E.** Utilization of a landslide area for a structure location, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 312–327, illus., 1968.

The geology of the area around the Elbert pump generating plant, in the headwaters of the Arkansas River in Colorado, is described. The area is to receive water from a series of tunnels drilled through the mountains across the continental divide to deliver water from the westward flowing Fryingpan River to the eastward flowing Arkansas. Glacial moraines are common, making landslides likely. The planned reservoir will be lined with several feet of clay to make an impervious bed; the penstock, leading the water from the reservoir to the power plant, will be built along the surface and not in moraine material.—HRC

04591 **Hall, Francis R.** Base-flow recessions—A review: Water Resources Research, v. 4, no. 5, p. 973–983, 1968.

Hydrologists have studied base-flow recessions for one hundred years or more. By the early nineteen hundreds much of the basic mathematical development was completed and some methods of hydrograph analysis were known. Recent mathematical work has the advantage of assessing more closely effects of the simplifying assumptions used to obtain solutions. Most workers preferred to follow graphical or statistical rather than mathematical approaches. The reasons appear to lie mainly in problems caused by the assumptions and in difficulties in interpreting the real stream hydrograph; also, base flow can come from many sources besides ground water. Other complications arise froom the question of whether the basin response is linear or nonlinear, because the response is a function of geologic and hydrologic factors in addition to those considered in the mathematical derivations.—*from* Author's abstract

05021 **Hall, John W.; Peake, Nancy M.** Megaspore assemblages in the Cretaceous of Minnesota: Micropaleontology, v. 14, no. 4, p. 456–464, illus., 1968.

A mid-Cretaceous Minnesota lacustrine deposit, capped by a lignite and then channeled by a Cretaceous stream, has yielded a number of megaspores of both aquatic ferns and aquatic and terrestrial lycopods. Distribution of these megaspores shows differences in percentages in the several depositional environments. The lacustrine and fluvial deposits contain spores derived from the uplands, as well as those also occurring in the lignite. The lignite, representing deposition in a swamp, lacks *Costatheca* and *Spermatites*, and has a high incidence of *Tenellisporites*. Two new species are described, *Tenellisporites spiinatus* and *Ariadnaesporites varius*.—*from* Authors' abstract

Hamelin, Louis-Edmond. *See* Clibbon, Peter B. 05037

04564 **Hamilton, E. I.; Farquhar, R. M.** (editors). Radiometric dating for geologists: London and New York, Interscience Publishers, 506 p., illus., tables, 1968.

This is a compilation of papers intended to supply source material that complements basic texts of geochronology. Those papers that fall within the scope of this bibliography are cited under the separate authors.—AGI Staff

04698 **Hamilton, E. I.** The isotopic composition of strontium applied to problems of the origin of alkaline rocks, *in* Radiometric dating for geologists (E. I. Hamilton and R. M. Farquhar, editors): London and New York, Interscience Publishers, p. 437–463, illus., tables, 1968.

The similarity of initial Sr-87/Sr-86 ratios in basic and alkaline rocks is held to suggest that these rocks are derived from a common environment.—HF

Hamilton, M. *See* Nishita, H. 04989

Hampton, W. J. *See* Kramer, Henry H. 04706

Handy, R. L. *See* Lohnes, R. A. 04846

Hansen, H. J. *See* Birkelund, T. 05158

04816 **Hansen, John.** Niobium mineralization in the Ilímaussaq alkaline complex, south-west Greenland, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 7, Endogenous ore deposits: Prague, Academia, p. 263–273, tables, 1968.

The Ilímaussaq alkaline intrusion is composed mainly of agpaitic nepheline syenites. The rocks have been formed under a roof of contemporary lavas. Niobium minerals are found in sheared lavas, gabbros, anorthosites and augite syenites from the roof of the agpaitic rocks. Niobium minerals also occur in hydrothermal veins in the agpaitic rocks. The most important of the niobium minerals are pyrochlore and minerals of the epistolite-murmanite group. It is suggested that the niobium is derived from the latest phases of agpaitic rocks. Murmanite, epistolite, and pyrochlore constitute from less that 1 to more than 10 percent of the rock.—*from* Author's abstract

05024 **Hansen, John.** A study of radioactive veins containing rare-earth minerals in the area surrounding the Ilímaussaq alkaline intrusion in South Greenland [with Russian abs.]: Medd. Grönland, v. 181, no. 8, 47 p., illus., tables, 1968; *reprinted as* Grönlands Geol. Undersögelse Bull. 76, 1968.

Monazite and bastnaesite are found in tension joints on the eastern side of the Ilímaussaq intrusion. The veins are from a few mm to about 3 m wide; most commonly they are 1 to 10 cm wide. Most of the radioactivity is due to thorium, the content ranging from 60 to 4,500 ppm; the uranium, locally more abundant than thorium, ranges from 17 to 1,700 ppm. The radioactivity is predominantly connected with the pigmentary material, thorite, thorianite, monazite, and bastnaesite. Other minerals identified in the veins are aegerine, acmite, albite, arfvedsonite, apatite, biotite, calcite, chlorite, eudialite, fluorite, hematite, lithium mica, mesodialite, microcline, neptunite, pyrite, quartz, and sphalerite. It is suggested that the veins formed at shallow depth and at low temperatures.—*from* Author's abstract

05113 **Hansen, Kaj.** Landskabsformer, sedimenter og frostfaenomener i Grönland [abs.]: Dansk Geol. Foren. Medd., v. 18, no. 1, p. 143–144, 1968.

04827 **Hanson, Kenneth; Berg, Eduard; Gedney, Larry.** A seismic refraction profile and crustal structure in central interior Alaska: Seismol. Soc. America Bull., v. 58, no. 5, p. 1657–1665, illus., tables, 1968.

An unreversed seismic refraction profile was obtained during the winter of 1966–1967 from several small chemical explosions in an open pit coal mine near Suntrana, Alaska. The profile runs from south to north across the Tanana Basin in central interior Alaska. Both P and S waves, generated by the explosions, were observed out to a distance of 217 km from the shot point. A four-layer crustal model is adopted to explain the first and later prominent seismic phases. The P velocities range from 3.67 kmps in the sedimentary surface layer to an apparent value of

8.83 kmps in the upper mantle. It is assumed that the Moho is dipping to the south under the Alaska Range, from a depth of 32 km at Fairbanks to approximately 48 km under the shot point.—Authors' abstract

Hanson, L. W. *See* Lerbekmo, J. F. 05069

Hara, Koichi. *See* Tomura, Teruichi. 04750

04704 **Harbaugh, John W.** Stratigraphy and geologic time: Dubuque, Iowa, Wm. C. Brown Co. Publishers, 113 p., illus., tables, 1968.

This book may be useful as a supplementary text in historical geology, and should be useful as a review for more advanced students in geology. The first five chapters deal largely with concepts of stratigraphy that pertain to qualitative age relationships—geologic time scale, stratigraphic correlation, unconformities, thickness maps and paleogeologic maps, and sedimentary facies; the sixth chapter deals with radiometric age dating—radioactive decay and its application to quantitative measurement of geologic time.—MCM

Harkrider, David G. *See* Anderson, Don L. 04824

04805 **Harrill, J. R.** Hydrologic response to irrigation pumping in Diamond Valley, Eureka and Elko Counties, Nevada, 1950–65: Nevada Dept. Conserv. and Nat. Resources Water Resources Bull. 35, 85 p., illus., tables, 1968.

Nearly all ground-water development has been in the southern half of Diamond Valley. In 1965 total net pumpage was 12,000 acre-feet, less than half of the estimated 30,000 acre-feet for the valley. Because most pumping occurs about 10 miles south of the nearest area of natural discharge, local overdraft will occur long before an appreciable amount of natural discharge can be salvaged. Pumping from 1950–65 has resulted in an estimated storage depletion of 60,000 acre-feet, roughly equal to total net pumpage, and only 3 percent of the 2 million acre-feet estimated to be in storage in the upper 100 feet of saturated alluvium in the South Diamond subarea. Pumpage increased about 2,000 acre-feet per yr between 1960–65; if the same rate increase prevails, new equilibrium may not be achieved until increased pumping costs result in a decrease or relocation. Chemical quality of water in 1965 was satisfactory.—*from* Author's abstract

Harrison, C. G. A. *See* Francheteau, Jean. 05000

04893 **Harriss, Robert C.; Crocket, J. H.; Stainton, M.** Palladium, iridium and gold in deep-sea manganese nodules: Geochim. et Cosmochim. Acta, v. 32, no. 10, p. 1049–1056, tables, 1968.

The abundance and distribution of Pd, Ir, and Au has been determined in manganese nodules from widely varying locations and geological environments within the Atlantic, Indian and Pacific Oceans. The distribution of these metals is characterized by a lack of distinct regional variations, homogeneous distribution within an individual nodule, and a lack of any correlation with variations in major and other trace elements in the nodules. Assuming that all the Ir in the manganese nodules is of extraterrestrial origin, an upper limit on the mass accretion rate of interplanetary matter to the Earth is calculated to be 60 tons per day over the surface of the Earth.—Authors' abstract

Harry, W. T. *See* Bridgwater, D. 05025

Hart, Pembroke J. *See* Knopoff, Leon. 04674

04566 **Hart, S. R.; Davis, G. L.; Steiger, R. H.; Tilton, G. R.** A comparison of the isotopic mineral age variations and petrologic changes induced by contact metamorphism, *in* Radiometric dating for geologists (E. I. Hamilton and R. M. Farquhar, editors): London and New York, Interscience Publishers, p. 73–110, illus., 1968.

Discussion of contact temperatures from heat-flow theory, sample collection and analytical procedures, effect of the contact metamorphism on the mineralogy, mineral age variations, age variations as diffusion phenomena, and comparison of mineral age stabilities and their relationship to metamorphic facies is included. The contact zone of the Eldora stock of Colorado is cited as an example.—AGI Staff

05033 **Harvey, Ralph L.** West Campbell—Key to unlock Hunton, Pt. 1: Oil and Gas Jour., v. 66, no. 43, p. 124–132, illus., 1968.

This is an abridged version of an article which appeared in Shale Shaker, v. 18, no. 9, p. 183–195, 1968 (*see* R. Harvy, Abstracts of North American Geology, February 1969).—HHA

05034 **Harvey, Ralph L.** Surface only scratched in Hunton search, Pt. 2: Oil and Gas Jour., v. 66, no. 44, p. 142–143, illus., 1968.

This is Part 2 of a two-part article. Part 1 titled "West Campbell—Key to unlock Hunton" (Oil and Gas Jour., v. 66, no. 43, p. 124–132, 1968; Shale Shaker, v. 18, no. 9, p. 183–195, 1968) includes a discussion of the stratigraphy and depositional history of the Hunton Group (Silurian and Devonian) in the Anadarko basin of Oklahoma. In Part 2, the author outlines a technique for making net porosity isopach maps of the dolomite facies of the Hunton and briefly discusses the economic aspects of the West Campbell, Star, North Custer City, and Aledo oil and gas fields.—HHA

Harward, M. E. *See* Borchardt, G. A. 04810

04995 **Hatherton, Trevor.** Through the looking glass—A comparative study of New Zealand and California: Nature, v. 220, no. 5168, p. 660–663, illus., 1968.

By reversino the two-dimensional geologic map of California and comparing it with New Zealand, the similarity in absolute size as well as in geometry of some of the structural provinces is evident. Similarities are pointed out in geosynclinal sediments, ultramafic belts, and transcurrent faults; late Cenozoic and recent acid to intermediate volcanics; geothermal power areas and geysers; and contiguous areas. These similarities suggest that simple, regular physical forces are at work at the edges of continents (the Campbell Plateau off New Zealand is of essentially continental nature).—DBV

04990 **Haven, Dexter S.; Morales-Alamo, Reinaldo.** Occurrences and transport of faecal pellets in suspension in a tidal estuary: Sed. Geology, v. 2, no. 2, p. 141–151, illus., tables, 1968.

In the White Shoal area of the James River, Va., recognizable faecal pellets formed an average of 0.42 percent by weight of the total suspended solids at 1 m above the bottom and 0.14 percent by weight at 1 m below the surface during a 24-hour sampling period. Pellets retained on soil analysis sieves, however, formed an average of 26.6 and 19.26 percent by weight, respectively, of the materials retained on the screens at the same depths. The pellets were apparently being transported in suspension. Although quantities in suspension were small, it is suggested that sorting during transportation and deposition could result in accumulation in areas of the estuary where fine sediments would not settle out. Such accumulations on the bottom could alter the textural and chemical characteristics of the existing sediments because of the fine size and chemical properties of the component particles of the pellets.—Authors' abstract

Hawley, J. W. *See* Gile, L. H. 04821

Hayes, John B. *See* Schroeder, Richard J. 05093

04694 **Heezen, Bruce; Hollister, C.** Mut'yevyye potoki i oledeneniye, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 83–93, illus., tables, 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

04651 **Heinrich, Kurt F. J.** Common sources of error in electron probe microanalysis, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 40–55, illus., table, 1968.

In order to reduce the error of quantitative electron probe microanalysis, error sources in preparation and measurement of specimens and standards must be minimized. These sources are described, and literature references for detailed study are given. A critical analysis is made of 150 analytical measurements of binary specimens previously discussed by Poole and Thomas. It is shown that serious errors reported by these authors are due mainly to poorly characterized or measured specimens and, in some cases, to omission of characteristic fluorescence corrections. If these are eliminated, a more favorable error distribution can be obtained through relatively simple correction calculations. Further progress in quantitative microprobe analysis is dependent upon measurements under well-controlled conditions and standard materials of experimentally proven microhomogeneity and reliably determined composition.—*from* Author's abstract

04687 **Helsley, C. E.; Stehli, F. G.** Sopostavleniye magnitnykh i zoogeograficheskikh dannykh o polozhenii polyusa v permskom periode, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 356–361, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

04573 **Hendricks, R. W.; Arrington, J. S., Jr.; Mason, W. J.** An automatic balanced filter device for X-ray diffraction experiments: Jour. Appl. Crystallography, v. 1, pt. 2, p. 128–130, illus., 1968.

An automatic balanced filter box which may be used on most standard X-ray diffraction tubes is described. It is designed to be used in conjunction with a wide variety of automated X-ray diffraction experiments to change Ross filters and insert attenuators into the incident X-ray beam on receipt of appropriate commands from the control system. The positions of the filters and attenuators may be displayed at all times by using feedback signals generated by a combination of light sources and photocells.—Authors' abstract

Herbertson, J. G. *See* Barr, D. I. H. 04589

Herbertson, John G. *See* Barr, David I. H. 04588

04843 **Hermes, O. Don.** Petrology of the Mecklenburg gabbro–metagabbro complex, North Carolina: Contr. Mineralogy and Petrology, v. 18, no. 3, p. 270–294, illus., tables, 1968.

The Mecklenburg complex of the Carolina Piedmont, consists of older metagabbro and metafelsic rocks of upper amphibolite grade, and a younger post-metamporphic gabbro. On the basis of field data and gravity measurements, the younger gabbro is a plug-like body with steeply dipping contacts that may converge inward at relatively shallow depth; the pluton may extend only 8,000 to 15,000 feet into the subsurface. [A Bouguer anomaly map and a residual gravity profile over the complex are included.]—*from* Author's abstract

04840 **Herreid, Gordon.** Geological and geochemical investigations southwest of Farewell, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 26, 15 p., illus., table, geol. map, 1968.

Bedrock in this area along the northern edge of the Alaska Range is strongly deformed, locally crossbedded, early Paleozoic slate limestone with smaller areas

of middle(?) Paleozoic limestone; granitoid stock; numerous dikes of andesite, keratophyre, and rhyolite; and rhyolite flows(?). Recurrent movements along an upland block bounded by the Farewell fault have had a strong influence on emplacement of igneous rocks; emplacement of a dike swarm was probably related to movements along the Farewell fault. Stream sediments contain scattered nickel, copper, molybdenum, and zinc anomalies in the upper Middle Fork drainage; these are associated with diabase dikes and (or) black slate within and marginal to the silicified aureole around the granitoid stock at the head of Middle Fork; one small nickel-bearing pyrrhotite deposit is associated with diabase.—*from* Author's abstract

04841 **Herreid, Gordon.** Progress report on the geology and geochemistry of the Sinuk area, Seward Peninsula, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 29, 13 p,, illus., tables, geol. map, 1968.

Several mineralized localities indicated by numerous gossans and geochemical anomalies make up the Sinuk district. Geochemical anomalies found during the 1965 field season at the Quarry and Galena prospects, the Monarch gossan, and elsewhere have been reported (Herreid, ibid., Rept. 24, 1966). A geochemical anomaly discovered in 1966 on Aurora Creek is reported for the first time. This mineralized zone is at least 7,000 feet long and still open to the north; it seems to represent lenticular zones of silicification and dolomitization with associated pyrite, sphalerite, and minor galena and chalcopyrite, possibly controlled by faults in the schist. The geology is shown on a preliminary geological-geochemical map of the Sinuk area; geochemical data and several new assays are tabulated.—MCM

04639 **Hess, H. H.; Poldervaart, Arie.** (editors). Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 2: New York and London, Interscience Publishers, p. 483–862, illus., tables, 1968.

The various papers in this second and concluding volume are cited under the separate authors. The papers in the first volume, published in 1967, are cited in the July 1968 issue of the Abstracts of North American Geology.—MS

05055 **Hills, F. Allan; Gast, P. W.; Houston, R. S.; Swainbank, I. G.** Precambrian geochronology of the Medicine Bow Mountains, southeastern Wyoming: Geol. Soc. America Bull., v. 79, no. 12, p. 1757–1783, illus., tables, geol. map, 1968.

The Medicine Bow Mountains are crossed by a northeast-trending shear zone, northwest of which is a gneissic complex overlain by more than 35,000 feet of miogeosynclinal metasedimentary rocks. Rb-Sr whole rock isochrons indicate that the gneiss is 2410±50 m.y. old and a biotite Rb-Sr date indicates that the metasedimentary rocks are at least 1550±50 m.y. old. Southeast of the shear zone is a gneiss which is intruded by a pegmatite yielding mineral isochrons ranging from 1455±40 to 1570±40 m.y. and by a granite yielding a whole rocks isochron of 1335±30 m.y. We suggest the miogeosynclinal rocks in the northern Medicine Bow Mountains are correlative with Animikie and Huronian strata and that the gneiss in the southern part of the Mountains and also the gneiss and graywacke of the Front Range may be more metamorphosed, eugeosynclinal counterparts—*from* Authors' abstract

Himmelberg, G. R. *See* Thayer, T. P. 04814

Hines, M. S. *See* Halberg, H. N. 04806

05004 **Hodge, Paul W.; Wright, Frances W.** Studies of particles for extraterrestrial origin—[Pt.] 6, Comparisons of previous influx estimates and present satellite flux data: Jour. Geophys. Research, v. 73, no. 24, p. 7589–7592, illus., 1968.

In light of recent satellite experiments made by us and by others, we re-evaluate our previous identifications of extraterrestrial particles found in polar ice sediments and atmospheric and terrestrial-surface collections. Only a very small number of those particles previously assigned a tentative extraterrestrial origin can be micrometeorites or ablation products from small meteoroids. The estimated influx of Fe/Ni particles in polar ice, however, is not consistent with the satellite data. The origin of the remainder of the particles remains unknown, but there is the

possibility that recent findings about the incidence of very large cometary meteors may be relevant.—Authors' abstract

05032 **Holland, Charles T.; Olsen, David A.** Interfacial friction, moisture and coal pillar strength: Soc. Mining Engineers Trans., v. 241, no. 3, p. 323–328, illus., table, 1968.

Interfacial friction is an important element in the formula for determination of coal pillar strength, although it does not appear as a factor. For this reason, it is important in mining practice to determine the coefficient of interfacial friction between a coal pillar and its top and bottom rock contacts. Experimental studies are reported here between coal and sandstone, limestone, and bottom and top shale (Pittsburgh coal). Coals investigated included the Elkhorn No. 3 of eastern Kentucky, Pittsburgh of northern West Virginia, and Pocahontas Nos. 3 and 4 of southern West Virginia. Tests were made under both wet and dry conditions; results are tabulated. Coal thoroughly saturated with water should be used in tests because some coals lose compressive strength when saturated.—VSN

Hollister, C. *See* Heezen, Bruce. 04694

Holowaychuk, N. *See* Blevins, R. L. 04820

Hooker, Marjorie. *See* Shrock, Robert R. 04622

05040 **Hopkins, M. E.** Harrisburg (No. 5) coal reserves of southeastern Illinois: Illinois Geol. Survey Circ. 431, 25 p., illus., table, geol. map, 1968.

This widespread member of the Carbondale Formation has been extensively mined near its outcrop. The known resource area is extended northward into the Fairfield basin, in the Illinois basin, by interpretation of coal thickness from conventional electric logs. Potential low-sulfur coal lying mostly in northern Saline County can be extended in a belt 4 to 10 mi wide into Indiana. Coal thicknesses are variable, in some areas estimated at 8 feet or more, and overlain by a gray silty shale, herein named the Dykersburg Shale Member, which intervenes between the coal and overlying black shale and/or St. David Limestone Member. Thickness estimations for the coal and overlying shales are shown on the geologic map, across which runs a narrow sinuous sandstone-filled channel, believed to be contemporaneous with the coal. Estimated coal reserves for this area total 11.8 billion tons.—*from* Author's abstract

05003 **Horai, Ki-iti; Simmons, Gene.** Seismic travel time anomaly due to anomalous heat flow and density: Jour. Geophys. Research, v. 73, no. 24, p. 7577–7588, illus., tables, 1968p

The effects on seismic traveltimes of (1) excess temperatures associated with the low-order harmonics of the surface heat flow and (2) excess mass estimated from the high-order harmonics of the Earth's gravitational field as determined from satellite orbits are calculated. The results are compared with the data of heat flow and the seismic time delays of Longshot, an underground nuclear explosion in the Aleutians. It is suggested that the thermal field rather than the density of the Earth may be a major cause of the seismic traveltime anomaly.—Authors' abstract

Houston, R. S. *See* Hills, F. Allan. 05055

05076 **Howard, J. H.** The role of displacements in analytical structural geology: Geol. Soc. America Bull., v. 79, no. 12, p. 1847–1853, illus., tables, 1968.

In two dimensions, information on the x and y components of displacements of points from their undeformed state to their deformed state permits the two dimensional determination of strains. The spatial derivation of the x and y displacements functions are related to the transformation constants of finite homogeneous strain and, in turn, to the state of strain. The practical problem of strain analysis based on the movements of points is to construct various valid mathematical functions (for example, the displacements function) from limited data.

This article shows that geologists can graphically construct these functions and in turn make analyses of strain.—*from* Author's abstract

04634 **Hoy, Robert B.** Memorial to Arthur Coe Spencer (1871–1964): Geol. Soc. America Proc. 1966, p. 387–392, portrait, 1968.

04744 **Hsu, Pa Ho.** Heterogeneity of montmorillonite surface and its effect on the nature of hydroxy-aluminum interlayers [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 4, p. 303–311, tables, 1968.

An Arizona bentonite was treated with hydroxy-aluminum solutions of various basicity; retaining strength of cation exchange sites was found to vary from very weak, where Al polymers were loosely held, to very strong, with which stable interlayer Al-clay complexes were formed. When a large amount of clay was treated with a small amount of solution, polymers were held only in positions of strong affinity, were difficult to extract with neutral salt solution, and did not change to crystalline $Al(OH)_3$ during prolonged aging. When a small amount of clay was treated with a large amount of solution, exchange sites were completely occupied by polymers, a portion of which was easily extractable, and changed to $Al(OH)_3$ during aging. This contrast is significant in comparing results obtained under difficult experimental conditions, and in correlating experiments with natural occurrence of gibbsite and interlayer Al-clay complexes.—ESL

05007 **Huang, J. H.; Ramsey, T. L.** Fluid flow in porous media—Diffusion and flow of nitrogen gas in natural rocks: Jour. Geophys. Research, v. 73, no. 24, p. 7685–7692, illus., tables, 1968.

A theory of gas flow in porous media is presented. The flow regime includes Knudsen flow, slip flow, and Poiseuille flow. The basic model is developed from a solution for flow in capillary tubes of any cross-sectional area. Analysis of several flow studies on natural rocks exhibiting different pore size distributions and variations in pore geometry are presented.—Authors' abstract

04697 **Hulley, J. C. L.** Sootnosheniye mezhdu gravitatsionnymi anomaliyami, sdvigovymi narusheniyami i polozheniyem polyusov, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 129–132, illus., table, 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

Hussong, D. M. *See* Furumoto, Augustine S. 04666

Hwang, Li-San. *See* Vanoni, Vito A. 04581

Ikawa, Haruyoshi. *See* Sherman, G. Donald. 05108

Irving, E. *See* Briden, J. C. 04696

05094 **Isaacs, Thelma.** Titanium substitutions in andradites: Chem. Geology, v. 3, no. 3, p. 219–222, tables, 1968.

Titanium-bearing andradites were studied by electron probe microanalysis and wet chemical analysis to determine the relation of titanium with iron and silicon, and the valence state of the titanium. Titanium is in the trivalent state and replaces iron in these minerals.—Author's summary

Iwasaki, B. *See* Iwasaki, I. 04659

04659 **Iwasaki, I.; Katsura, T.; Ozawa, T.; Yoshida, M.; Iwasaki, B.** Chlorine content of volcanic rocks and migration of chlorine from the mantle to the surface of the Earth, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 423–427, illus., tables, 1968.

Results of analysis of more than 500 samples of volcanic and plutonic rocks have led to formulation of a theory of migration of chlorine involving incorporation of chlorine compounds in magmatic melts and their gradual ascent in magmatic gases. Throughout geologic time sufficient quantities have migrated from the mantle to account for the chlorine content of oceanic waters.—MS

Izett, Glen A. *See* Taylor, Richard B. 05126

05064 **Jackson, E. D.** The character of the lower crust and upper mantle beneath the Hawaiian Islands, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 1, Upper mantle (geological processes): Prague, Academia, p. 135–150, illus., table, 1968.

The Hawaiian Ridge is an arcuate chain of shield volcanoes that is progressively younger toward the southeast. Seismic evidence indicates crustal thicknesses of 11–20 km under these shields, which have been built by successive eruptions of tholeiitic basalt, followed by eruptions of much smaller amounts of alkalic basalt, ankaramite, hawaiite, trachyte, and, in some cases, nephelinite. The physical properties of layered cumulates are compatible with observed geophysical properties of crustal material under the shields. The textures, structures, mineral assemblages, and physical properties of xenoliths found in alkalic basalt and nephelinite suggest that they are fragments of subcrustal rocks, and that the upper mantle under the Hawaiian Ridge is heterogeneous either geographically or in depth. Seismic data place the origin of tholeiitic magma as deep as 60 km.—*from* Author's abstract

04641 **Jaeger, J. C.** Cooling and solidification of igneous rocks, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 2 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 503–536, illus., tables, 1968.

The theory of sudden emplacement of magma at a uniform temperature and cooling by conduction into country rock with the same thermal properties as the magma is held to be valid, although somewhat simplified. Solutions for various idealized situations corresponding to geologic conditions are derived; these are applied to problems involving complicated shapes and extended to test quantitatively the effect of the various assumptions. Processes involved in solidification of the magma are discussed, first in terms of the theory that crystallization proceeds in place, with emission of latent heat but without differentiation or movement of magma, and second, on the premise that a mechanism of differentiation and convection must be postulated.—MS

Jeffs, D. N. *See* Mellary, A. A. 05010

04727 **Jeletsky, J. A.; Tipper, H. W.** Upper Jurassic and Cretaceous rocks of Taseko Lakes map-area and their bearing on the geological history of southwestern British Columbia: Canada Geol. Survey Paper 67–54, 218 p., illus., tables, 1968.

The strata discussed range from the middle (?) Callovian Stage of Middle Jurassic to middle Upper Cretaceous. The oldest, 5,000–9,000 feet of argillaceous clastics, belong to the Relay Mountain Group. The base is faulted and a regional unconformity separates it from the overlying Jackass Mountain and Taylor Creek Groups. The Jackass Mountain Group (Aptian–lower (?)Albian) is composed of 15,000 feet of nonmarine clastics. The Taylor Creek Group, believed to be the marine equivalent of the Jackass Mtn. Group, is a series of black shales 10,000 feet thick. The conformably overlying Kingsvale Group consists of 15,000 feet of interbedded volcanics and clastics. A fossil flora indicates latest Albian(?) to Late Cretaceous age. Correlation charts and an appendix of thirty stratigraphic sections are included.—BSH

Jenkins, Farish A., Jr. *See* Crompton, A. W. 04779

04605 **Jespersen, Anna.** Memorial to Jewell Jeannette Glass (1888–1966): Geol. Soc. America Proc. 1966, p. 225–227, portrait, 1968.

Jessen, F. W. *See* Fertl, Walter. 04745

04632 **Jewett, John Mark.** Memorial to Walter H. Schoewe (1891–1966): Geol. Soc. America Proc. 1966, p. 375–378, portrait; 1968.

04756 **Johnson, G. G., Jr.; Vand, V.** Computerized multiphase X-ray powder-diffraction identification system, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 376–384, illus., 1968.

The search system is written in both FORTRAN II for the IBM 7074 and in FORTRAN IV for the IBM 360/65. It gives the chemist an additional analytical tool (using X-ray diffraction) which can be used to identify small polycrystalline samples. This method of identification, previously used only by diffractionists, can be used with minimal experimental techniques and yields correct results of six component mixtures in less than two minutes of computer time.—Authors' conclusions

Johnson, Helgi. *See* Williams, M. Y. 04607

04673 **Johnson, Rockne H.; Norris, Roger A.; Duennebier, Frederick K.** Abyssally generated *T* phases, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 70–78, illus., table, 1968.

Two distinct types of signals have been identified from studies of *T*-phase spectra and source locations. One, with its source at a shoaling slope of the ocean bottom and with dominant frequencies near 4 cps, is the previously recognized and described classic *T* phase. The other, with its source in deep water and with dominant frequencies near 30 cps, is newly identified and is here termed the abyssally generated, or abyssal, *T* phase. Scattering from the sea surface is proposed as a mechanism for producing rays which propagate through the ocean with an apparent velocity equal to sofar velocity. It is hypothesized that the sea surface roughness shapes the spectrum of the abyssal *T* phase. A synthesis of the power-level record relates the degree of sharpness of the abyssal *T*-phase peak with focal depth. Authors' abstract

05120 **Johnson, Ross B.** Volcanic terranes adjoining the central Sangre de Cristo Mountains of Colorado and New Mexico [abs.], *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 239, 1968.

Johnstone, Donald L. *See* Crosby, James W., 3d. 04570

04853 **Jones, R. W.; Ross, S. H.; Williams, R. E.** Feasibility of artificial recharge of a small ground water basin by utilizing seasonal runoff from intermittent streams, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 258–282, illus., 1968.

Ground water occurs in almost all types of rocks in the Moscow basin of Idaho. The surficial material, loess and lacustrine deposits, are not important aquifers. Three hydrologic zones exist in the underlying Columbia River Group, each consisting of an upper subzone of basalt flows and a lower subzone of sedimentary interbeds, the latter pinching out toward the west. East zone contains one or more artesian aquifers. Artificial recharge is recommended to overcome the loss of artesian pressure, the water coming from intermittent surface streams.—HRC

04626 **Jones, Walter B.** Memorial to Edward Franklin Richards (1903–1965): Geol. Soc. America Proc. 1966, p. 351–352, portrait, 1968.

05015 **Jost, Manfred.** Microfossils of problematic systematic position from Precambrian rocks at White Pine, Michigan: Micropaleontology, v. 14, no. 3, p. 365–368, illus., 1968.

Three types of problematic siliceous microfossils from Late Precambrian (Keweenawan) rocks at White Pine, Michigan, are described and illustrated.—Author's abstract

05083 **Kaddah, Malek T.** Cesium and rubidium fixation in vermiculite and hydrobiotite: Soil Sci., v. 106, no. 1, p. 67–72, illus., tables, 1968.

In hydrobiotites and vermiculites, the lattice expanding Na ions were less effective than K ions in displacing adsorbed Cs, and the order of effectiveness was reversed in the displacement of adsorbed Rb. This is due to the strength of attachment of displacing cations to the minerals in Cs-saturated minerals and the size of the displacing cations in comparison with the adsorbed cations in Rh-saturated minerals.—JWH

04707 **Kanasewich, E. R.** The interpretation of lead isotopes and their geological significance, *in* Radiometric dating for geologists (E. I. Hamilton and R. M. Farquhar, editors): London and New York, Interscience Publishers, p. 147–223, illus., 1968.

Experimental results indicate that single-stage isochrons are either very short or do not exist. On the other hand, the evidence for a unique growth curve or narrow growth band for continental leads is good and the data along it may be interpreted with a single-stage model. The hypothesis of multi-stage lead development is based on the episodic nature of orogenesis. It appears that a large proportion of lead isotope measurements may be interpreted on the basis of development in two or more uranium and thorium systems. The model assumes that the initial stage of lead isotope development occurred in a system having uniform uranium, thorium, and lead. The calculated thorium/uranium ratios show that subsequent stages of development have occurred in a crustal sialic environment.—Author's abstract

05063 **Kanasewich, E. R.; Clowes, R. M.** Geophysical studies of the Earth's crust and upper mantle in western Canada, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 1, Upper mantle (geological processes): Prague, Academia, p. 239–247, illus., 1968.

Continuous seismic reflection profiles have been combined with gravity and magnetic observations and petrological information to obtain a crustal section in southern Alberta. Several reflecting horizons appear to be continuous over distances of at least 30 km and outline a major east-west tectonic feature in the 2 b.y. old basement below a flat lying sedimentary section. A faulted syncline or possibly a graben extends for several hundred km across southern Alberta into British Columbia. Structural relief is a minimum of 9 km on a 30 km deep reflecting horizon. A combination of seismic velocities and Bouguer gravity anomalies is used to develop a model of the crustal section, which indicates that density differences in the upper mantle are involved in the development of the observed tectonic features.—*from* Authors' abstract

Kaplan, I. R. *See* Presley, B. J. 04865

Katajeva, Z. T. *See* Semenov, E. I. 04701

Katsura, T. *See* Iwasaki, I. 04659

05088 **Kay, Marshall.** North Atlantic continental drift, *in* Gondwanaland revisited—New evidence for continental drift: Am. Philos. Soc. Proc., v. 112, no. 5, p. 321–324, illus., 1968.

Stratigraphic and structural similarities between Newfoundland and the British Isles indicate that they were once related geologically. They are now separated by sea-floor spreading and since the Newfoundland belts trend to the north of those of the British Isles, it would seem that North America has moved right-laterally with regard to Europe, and that the two sides separated normal to the Atlantic rift. The geologic evidence suggests that the transcurrent movement was in the early Mesozoic and that the separation has continued from that time. Shelves, on which Triassic rocks were deposited, were present in the Triassic (with the rift valleys of the eastern Unitedd States being not unlike those initiated in the Carboniferous of the Newfoundland area) of North America and England; Jurassic and Cretaceous rocks are known from the Atlantic Ocean.—HRC

Kazakova, M. E. *See* Semenov, E. I. 04700

04850 **Keightley, W. O.; Frazier, G. A.** Earth dam undergoes earthquakes, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 195–224, illus., tables, 1968.

The Fort Peck dam, in Montana, was used as an example to determine the effects of earthquake waves on dams and foundations. Artificial explosions were created in the nearby Bearpaw Shale, and the effects of the seismic waves on the dam were recorded by geophones. Synchronized records of motions at various points along the dam and foundation were recorded. Motions due to different sizes of explosions were compared, as were the character of the foundation motions and motions of the dam.—HRC

04577 **Kemp, Patrick H.; Plinston, David T.** Beaches produced by waves of low phase difference: Am. Soc. Civil Engineers Proc., v. 94, paper 6100, Jour. Hydraulics Div., no. HY5, p. 1183–1195, illus., 1968.

A theoretical and experimental study of the action of swell waves on model beaches shows that the beach slope and the distance from the shore to the breakers correlate with the breaker height, wave period, and grain diameter. The experiments were carried out using quartz sands and wave periods in the range of 0.8 to 1.34 sec. Wave heights were used up to a maximum breaker height of 6 cm. The waves employed were of low phase difference, i.e., the ratio of time of uprush to wave period being less than 0.7. When this ratio is exceeded, the wave period ceases to be important. Using a continuity approach it is shown that the energy lost in breaking, friction and turbulence and in moving material, amounts to about 25 percent of the incident wave energy when the beach angle is highest, to about 50 percent when the beach is at its lowest level within the range considered.—Authors' abstract

04837 **Kempe, Walter F.** Core orientation, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 23–44, illus., 1968.

Field performance in coring thousands of feet shows that reliably oriented cores can be obtained on a commercial basis with the Christensen–Hugel technique. The core in this system is continuously grooved by three special knives and orientation is obtained by correlation between the grooves and pictures from a multishot survey instrument rotationally fixed on the stationary inner barrel assembly. Owing to the geological significance of oriented cores, these recent and current field developments give promise of expanding interest in core orientation and of helping geologists to improve their understanding of complex structural and stratigraphic conditions.—Author's conclusions

04583 **Kenney, T. Cameron; Shaukat Ali, M.** Stability of natural slopes in sensitive clay—Discussion [of paper 5311 by C. B. Crawford and W. J. Eden, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 6089, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1185–1190, illus., 1968.

In studying the Breckinridge slide, the authors have considered it as a large-scale shear-strengh test. Results were obtained from calculations on an assumed initial slide that was too large, so it was not realized that the actual initial slide occurred in soils where the stress magnitudes were much smaller than those used in the laboratory. This retrogressive slide was initiated by a single monolithic slide and increased in area by subsequent slides around the boundary of the scar. Critical stress curves are plotted, based on this interpretation, and are compared with those for similar Scandinavian slides.—ESL

04785 **Kent, D. M.** Wymark best hope for oil in Saskatchewan Duperow: Oilweek, v. 19, no. 38, p. 16–17, illus., 1968.

Areal distribution and stratigraphic position of porous and permeable dolomites in the Wymark Member of the Devonian Duperow Formation are re-evaluated. The dolomites are associated with evaporite deposits occurring at three levels in

the member, forming three informal units delineated by thin shaly beds. The middle unit, 200–250 feet, contains the highly porous and permeable dolomites which commonly underlie and extend beyond the evaporite basins. These dolomites are possible oil traps; similar lithologic types are found in reef complexes in central Alberta.—ESL

05092 **Kerns, Raymond L., Jr.; Mankin, Charles J.** Structural charge site influence on the interlayer hydration of expandable three-sheet clay minerals [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 1, p. 73–81, illus., tables, 1968.

Sites of layer charge deficiencies may influence the amount of hydration in interlayers. If interlayer cation-to-layer bonds are considered ideally electrostatic, magnitude of forces resisting expansion may be expressed as a form of Coulomb's law. If this effect is significant, expandable structures in which charge-deficiency sites are predominantly in the tetrahedral sheet should have less pronounced swelling properties. Relative degrees of interlayer hydration were measured for three samples that differed in location of layer charge sites but had similar interlayer cation compositions. No correlation could be made between degree of interlayer hydration and total surface-charge density, but does not eliminate total surface-charge density as being significant to swelling properties. Results indicate correlation between more intense expandability and predominance of charge deficiencies in the octahedral sheet.—*from* Editor's abstract

King, E. A. *See* Lafleur, L. D. 05151

05106 **King, H. F.** A foray into the realm of ore genesis: Mines Mag., v. 58, no. 12, p. 21–27, 1968.

Until recent years, many stratiform base-metal ore deposits were judged to have formed by replacement by hydrothermal solutions of hypogene origin, an idea that is currently being questioned in favor of syngenetic concentration. This philosophical paper is a lucid aand interesting review of the geologic reasons for this changing genetic concept. In order to define better exploration guides for stratiform mineral deposits, some Australian government agencies and mining companies jointly have established the Baas-Becking Geobiological Research Laboratory in Canberra, Australia, to study the genesis of these deposits.—RPF

Kirkham, Don. *See* Mansell, Robert S. 05081

Kishk, Fawzy M. *See* Barshad, Isaac. 05028

04813 **Klein, Cornelis, Jr.** Coexisting amphiboles: Jour. Petrology, v. 9, no. 2, p. 281–330, illus., 1968.

Previously published and new chemical analyses for various amphibole pairs are presented; they serve as a basis for determining the extent of miscibility gaps between amphibole series and the fractionation of the major elements between the two amphiboles of a pair. Among various conclusions it is noted that a consistently higher Mg/Mg + Fe ratio was found in calcic amphiboles than in the other member of anthophyllite-calcic amphibole and cummingtonite (grunerite)-calcic amphibole pairs and that small amounts of MnO tend to concentrate preferentially in anthophyllite or cummingtonite of anthophyllite-hornblende and cummingtonite-hornblende pairs.—MS

Klusman, Ronald W. *See* Meinschein, W. G. 05107

04674 **Knopoff, Leon; Drake, Charles L.; Hart, Pembroke J.** (editors). The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), 522 p., illus., tables, 1968.

Papers presented at a symposium held during the Pacific Science Congress in Tokyo (August 1966), together with selected papers from the geophysical section of the

Congress, have been assembled to form this monograph. The various papers are cited under the separate authors.—MS

Koehler, F. E. *See* Roberts, S. 04986

04874 **Koerner, R. M.** Fabric analysis of a core from the Meighen Ice Cap, Northwest Territories, Canada: Jour. Glaciology, v. 7, no. 51, p. 421–430, illus., 1968.

Ice samples from a 121 m core, representing the total thickness of the Meighen Ice Cap near its highest point, were studied for ice fabric, firn- and dirt-layer distribution. The absence of a strongly preferred fabric between the surface and the base of the ice cap at the core site suggests an absence of past or present ice movement at this point. From the variations of ice texture, firn- and dirt-layer distribution with depth, it is concluded that the ice cap post-dates the climatic optimum and has never been much thicker than it is at present. There is a possible relic ablation surface at a depth of 50 m which is estimated to be at least 500-600 years old.—Author's abstract

04752 **Koffman, Donald M.** An X-ray small-angle scattering instrument, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 332–338, illus., 1968.

An instrument is described which is used for recording X-ray diffraction patterns or small-angle scattering curves in an angular region very close to the direct beam. The measurement of X-ray intensity is accomplished with standard geiger or scintillation counter techniques. The instrument, designed for use with a spot-focus or vertical-line X-ray source, is a multiple-reflection double-crystal diffractometer, employing two grooved perfect germanium crystals arranged in parallel position. This produces a monochromated X-ray beam which can be several millimeters wide while still exhibiting extremely high angular resolution. Principal features are discussed with emphasis on advantages over those employing complex slit systems and film-recording techniques. Illustrative data are presented.—*from* Author's abstract

05160 **Koschmann, A. H.; Bergendahl, M. H.** Principal gold-producing districts of the United States: U.S. Geol. Survey Prof. Paper 610, 283 p., illus., 1968.

The report contains descriptions of the geology, history, and production of the more than 500 mining districts of the United States that have produced at least 10,000 ounces of gold. California has been the leading producer, followed by Colorado, South Dakota, Alaska, and Nevada. Trends of production are noted, particularly the influence of such events as the increase of the price of gold in 1934 and the emergency period of World War II. Gold deposits are closely associated with small batholiths, stocks, and intrusive bodies of quartz monzonitic composition that range in age from Jurassic to Tertiary.—MHB

04668 **Kosminskaya, I. P.; Zverev, S. M.** Deep seismic sounding in the transition zones from continents to oceans, *in* The crust and upper mantle of the Pacific area-Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 122–130, illus., 1968.

New seismic data are presented showing that in oceanic and continental regions, both the crust and the mantle are thinly stratified. Comparison of velocity cross-sections of different transition zones reveals that, although well-defined in the crust and upper mantle below continents and island arcs, seismic interfaces and velocity layers are difficult to define in areas below oceans.—MS

04706 **Kramer, Henry H.; Hampton, W. J.; Molinski, Victor J.; Finn, James J.; Wahl, Werner H.** Oeographic characterization of chromium ore deposits by elemental analysis: Nuclear Applications, v. 5, no. 4, p. 260–262, tables, 1968.

Major and minor elemental constituents in a series of chromium ore samples [from California, Russia, Africa] were determined by neutron activitation analyses. The influence of the variable amount of gangue was minimized by comparing the ratios of the concentrations of the elements believed to be associated with the chromite

to the observed chromium concentration. The data obtained indicate that these ratios are significantly different enough for each ore deposit examined to be characteristic of their geographic origin.—Authors' abstract

04725 **Krumbein, W. C.** Statistical models in sedimentology: Sedimentology, v. 10, no. 1, p. 7–23, illus., tables, 1968.

Three stages of statistical development can be recognized in sedimentology. The first is descriptive statistics, in which the sample is the object of interest; the second is analytical statistics, in which the population assumes major importance. The third stage is application of stochastic process models in which the probabilistic elements are sought. Such models provide a way of examining processes through time or over an area, and with deterministic models they provide a framework for exploring the underlying physical, chemical, and biological controls on sedimentary processes and deposits with superimposed random fluctuations introduced by the "built in" probabilistic mechanism.—*from* Author's summary

04614 **Kugler, Hans G.** Memorial to Ralph Alexander Liddle (1896–1963): Geol. Soc. America Proc. 1966, p. 285–289, portrait, 1968.

04732 **Kulkarni, P. H.** Mineralographic characteristics of the nickel–cobalt–silver ores of Cobalt, Ontario, Canada: Nagpur Univ. Geol. Soc. Jour. 1964–68, v. 1, nos. 12–15, p. 24–32, illus. [1968].

The nickel–cobalt–silver ore–complex of Cobalt, Ontario contains an unusual assemblage of nickel and cobalt arsenides, sulphides, sulpharsenides and native silver with native silver with calcite and dolomite as gangue. Native bismuth, dyscrasite, argentite, stephanite, galena and sphalerite are present in minor amounts. Textural and mineralographic characters of these ores are described, and their paragenesis inferred and interpreted.—Author's abstract

Kullerud, G. *See* Naldrett, A. J. 05036

04644 **Kuno, Hisashi.** Differentiation of basalt magmas, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 2 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 623–688, illus., tables, 1968.

Differentiation takes place mainly by fractional crystallization, but may also be caused by liquid immiscibility, thermodiffusion, gaseous transfer, or other agents. If assimilation is involved, its effect is subordinate. Fractionation trends in rock series originating from the same type of parent magma exhibit marked diversity. The successive changes in magma composition accompanying separation of crystal phases, particularly in volcanic lavas, are discussed, and the principal features of tholeiite, high-alumina basalt, alkali rock, and calc-alkali rock series are defined.—MS

05058 **Kushiro, I.; Yoder, H. S., Jr.; Nishikawa, M.** Effect of water on the melting of enstatite: Geol. Soc. America Bull., v. 79, no. 12, p. 1685–1692, illus., tables, 1968.

Melting relations for the $MgSiO_3$ composition were studied at pressures between 5 and 30 kb under hydrous conditions. The beginning of melting of enstatite is about 1360°, 1280°, and 1270°C at 10, 20, and 30 kb, respectively. The incongruent melting behavior of enstatite persists to at least 30 kb water pressure. The melting interval where forsterite, liquid, and vapor co-exist is 30° to 50°C in the pressure range 10 to 30 kb. Below the solidus the assemblage enstatite + forsterite + vapor is obtained from the $MgSiO_3$ composition, because the vapor probably contained silica in excess of that in stoichiometric $MgSiO_3$. Silica-saturated magmas such as a quartz tholeiite magma may be generated at depths of at least as much as 100 km under hydrous conditions, either by direct partial melting of peridotites or by fractional crystallization of olivine tholeiitic magmas.—*from* Authors' abstract

Laag, A. E. *See* Luebs, R. E. 04981

LaBerge, Gene L. *See* Tri-State Geological Field Conf. 04793

05151 **Lafleur, L. D.; Goodman, C. D.; King, E. A.** Mössbauer investigation of shocked and unshocked iron meteorites and fayalite: Science, v. 162, no. 3859, p. 1268-1270, illus., tables, 1968.

Mössbauer spectra of several iron meteorites have been measured by a resonant scattering technique rather than by the conventional transmission method, thereby eliminating the necessity for the preparation of thin samples. No significant differences were observed in the spectra of specimens of mechanically deformed, shocked, and unshocked iron meteorites, nor in the absorption spectra of artificially shocked and unshocked fayalite.—Authors' abstract

04978 **Lahav, N.; Chen, Y.; Bar-Yosef, B.** Clay suspensions in a drying-out process: Soil Sci., v. 106, no. 4, p. 297-302, illus., 1968.

Na-, Ca-, and Mg-bentonite were dried out slowly over a wide range of water contents from dilute suspensions to concentrated paste. The experimental data showed satisfactory agreement with the theoretical calculations pointing to the presence of 3-5 platelets in a tactoid of Ca-or Mg-bentonite as compared with one in Na-bentonite.—JWH

04743 **Lailach, G. E.; Thompson, T. D.; Brindley, G. W.** Absorption of pyrimidines, purines, and nucleosides by Li-, Na-, Mg-, and Ca-montmorillonite (Clay-organic studies 12) [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 4, p. 285-293, illus., table, 1968.

Aqueous solutions had a range of pH values 2-12; initial organic concentrations were about 1 m. molar. The ratio clay to organic compounds was such that only up to 25 percent of the exchange capacity could be saturated by organic cations, but, depending on conditions, up to 100 percent of available organic material was absorbed. Of 19 compounds studied, only thymine, uracil, and their nucleosides were not absorbed. Absorption occurs primarily as a cation exchange reaction under acid conditions and varies with basicity of the compounds, their aromatic or nonaromatic character, and possible extent of their van der Waals interaction with silicate layers. Nucleosides generally are less strongly absorbed than their purines or pyrimidines because their nonplanar structure permits less van der Waals interaction; their absorption is influenced by differences in swelling behavior of montmorillonite with mono- and divalent cations.—*from* Authors' abstract

05023 **Lam, Jörgen; Pedersen, K. Raunsgaard.** Precambrian organic compounds from the Ketilidian of south-west Greenland, Pt. 2: Medd. Grönland, v. 185, no. 6, 15 p., illus., 1968; *reprinted in* Grönlands Geol. Undersögelse Bull. 74, 1968.

Material from well preserved Ketilidian beds over 2,000 m.y. old is described. The organic material comes from a dolomitic layer with great numbers of the globular fossil *Vallenia erlingi*. Of the two samples examined, one contains normal and branched alkanes with chain lengths from C_{10} to C_{20}, and various aromatic hydrocarbons including benzine derivatives and napthalenes. The other sample contains normal and branched alkanes with chain lenghts from C_{10} to C_{22} and does not show any aromaticity, although methyl esters of palmitic acid and other fatty acids are present. The presence of these compounds provides further evidence of the organic origin of *Vallenia*.—*from* Authors' abstract

04653 **Laney, R. L.** Investigation of the geochemistry of water in a semiarid basin in Arizona, U.S.A., *in* Congress of Istanbul, 1967—Internat. Assoc. Hydrogeologists Mem., v. 8: Ankara, Turkey, Turkish Natl. Comm., Internat. Assoc. Hydrogeologists, p. 559-565, illus., table, 1968.

Ground water in the Tucson basin is divided into seven chemical types on the basis of relative amounts of calcium, sodium, bicarbonate, and sulfate and the absolute amount of chloride; types are related to geohydrologic environments. Proximity to natural recharge areas and quality of recharge water have only local effects on chemical composition which is altered by the enclosing deposits within one to three miles of recharge areas. Changes in the transition from rain water to ground water

will occur where there are significant mineralogical changes in source area, streambed material, and deposits along path of ground-water movement; further changes are dependent upon lithology of deposits in direction of ground-water movement. Ion exchange and reactions related to lithification and cementation of deposits may modify composition of ground water.—*from* Author's conclusions

04786 **Langenheim, Jean H.; Beck, Curt W.** Catalogue of infrared spectra of fossil resins (ambers)—[Pt.] 1, North and South America: Harvard Univ. Bot. Mus. Leaflets, v. 22, no. 3, p. 65–120, illus., 1968.

Infrared spectra (149) of ambers of Cretaceous, early Tertiary, and unknown ages, are catalogued from all known localities in North and South America including: Arctic Coastal Plain of Alaska; Montana; Cedar Lake, Manitoba; 12 localities in U.S. Atlantic Coastal Plain; Chiapas and Baja California, Mexico; and the Dominican Republic. Significance of major absorption bands, as to geologic age and botanical origin, is discussed for fossil and modern resins. Paleoecology and conjectural botanical sources of the amber are discussed briefly for each locality; the 46 spectra curves reproduced are representative of the ambers and comparative modern resins. Chief sources of ambers from northern localities are coniferous gymnosperms; ambers from subtropical or tropical areas are chiefly from angiosperms, such as the legume *Hymenea*.—VMJ

05165 **LaValle, Placido.** Karst depression morphology in south central Kentucky: Geog. Annaler, v. 50A, no. 2, p. 94–108, illus., table, 1968.

The karst depression morphology in Carboniferous limestones of south central Kentucky is analyzed with respect to elements of lithology, structure, and relative location in the erosion system. It was found that mean depression area, relief, and flank slope inclination had large values where limestones had low mean soluble residue contents, hydraulic gradients in the erosion system were high, surface runoff in any areas was diverted underground, depressions were adjusted to lines of structural weakness, dense limestones were encountered, and areas were near the mouth of the karst drainage system. Regression studies of variations showed that 92 percent of depression relief, 70 percent of depression areas, and 73 percent of depression flank slopes are due to variations in lithology, structure, karst drainage geometry, and relative location in the erosion system.—GDC

Lawrence, D. E. *See* Aumento, F. 04726

Leopold, Estella B. *See* Dickinson, Robert G. 05157

05069 **Lerbekmo, J. F.; Hanson, L. W.; Campbell, F. A.** Application of particle size distribution to determination of source of a volcanic ash deposit, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 2, Volcanism and tectogenesis: Prague, Academia, p. 283–295, illus., tables, 1968.

The White River Ash is a volcanic deposit about 1,500 years old consisting of 20 cu km of rhyodacitic pumice and ash covering more than 300,000 sq km of eastern Alaska and the southern Yukon. The ash has been identified along the east-west lobe for at least 700 km; its exact source in the high ice-covered St. Elias Range of Alaska was unknown. Samples and thickness observations were taken at 132 locations along available roads. The model of Know and Short (1963), based upon radioactive fallout distributions, was applied to the size distribution of the White River Ash. The model placed the vent location at least 50 km beyond the limits of a "source area rectangle" indicated by the thickness distribution. Examination of aerial photographs within this rectangle revealed a possible pumice mound which was later verified as the source by helicopter access.—*from* Authors' abstract

05060 **Lespérance, Pierre J.** Faunal affinities of the trilobite faunas, White Head Formation, Percé region, Quebec, Canada, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 9, Stratigraphy of central European lower Paleozoic: Prague, Academia, p. 145–159, illus., tables, 1968.

The trilobite faunas of the White Head Formation are compared with other faunas of the same age, and the index of faunal resemblance is given for each case. Basal

trilobite faunas from the White Head, assigned to the Caradoc or Ashgill, are similar to those from European strata. The four Ashgillian faunas recognized have closest faunal affinities with the Drummuck Group, the North American Richmond or Ellis Bay Formations, or else with central European mudstones. Stratigraphically succeeding faunas have alternating European or North American affinities. The Llandoverian faunas are closest to the Girvan or Anticosti faunas of the same age. The alternating European or North American faunal affinities are taken to represent minor paleoecological differences atypical of provincial differences. The overall White Head fauna is described as an eclectic fauna.—*from* Author's abstract

Leviy, N. V. *See* Tarakanov, R. Z. 04671

Li, Y. H. *See* Broecker, W. S. 05100

05049 **Liese, Homer C.** Mineral compositions of selected granites and gneisses of New England: Geol. Soc. America Bull., v. 79, no. 12, p. 1859–1866, illus., table, 1968.

Infrared absorption spectrophotometry and ultraviolet emission spectrography were employed in order to obtain semiquantitative compositional data for certain minerals from selected granites and gneisses of New England. The minerals separated from each of 49 representative rock samples included: essential quartz, potassic feldspar, plagioclase, biotite, and accessory magnetite. The rock units and number of samples were: Conway granites, 14; Westerly granite, 3; Middletown and Monson gneisses, 10; Glastonbury and Maromas gneisses, 7; Stoney Creek, Clinton, and Sterling granitic gneisses, 8; and Canterbury gneiss, 7. The primary purpose of this preliminary reconnaissance survey was to determine if some of the data obtained would be consistent and systematically related to specific rock units. It is concluded that this has been demonstrated, and the indicative data have been emphasized.—*from* Author's abstract

Lipman, Peter W. *See* Steven, Thomas A. 05117

05118 **Lipman, Peter W.** Geology of the Summer Coon volcanic center, eastern San Juan Mountains, Colorado, *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 211–236, illus., table, 1968.

The Summer Coon center, a dissected strato-volcano in the Tertiary Conejos Formation a few miles north of Del Norte, Colo., consists of intrusive and extrusive rocks that range from basalt to rhyolite. The core of Summer Coon Volcano is a circular mosaic of small altered stocks ranging from diorite to quartz monzonite porphyry. Radiating from this core are hundreds of basaltic to rhyolite dikes. Sequence of dike injection and eruptive history can be inferred from the sequence of outward-dipping lava flows and breccias that flank the core and that are petrographically similar to radial dikes. Thick basal olivine basalt and andesite are overlain by local phenocryst-poor rhyolite and finally by varied phenocryst-rich rhyodacite and quartz latite.—*from* Author's abstract

04631 **Locke, Augustus.** Memorial to Harrison Ashley Schmitt (1896–1966): Geol. Soc. America Proc. 1966, p. 369–373, portrait, 1968.

04846 **Lohnes, R. A.; Handy, R. L.** Shear strength of some Hawaiian latosols, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 64–79, illus., tables, 1968.

In-situ bore hole shear tests at 2 to 3 feet depth indicate a cohesion of 0.5–0.9 psi, averaging 0.6 and an internal friction angle of 20–30° averaging 25°. Cohesion and internal friction vary systematically with rainfall. Kaolinite varied from 10 to 35 percent, being lower with more rainfall. Gibbsite and goethite contents increased with increasing rainfall in the range of 30–90 inches per year. A correlation ($r = 0.84$) was found between kaolinite content and cohesion. The calculated depth to failure on an infinite slope is 1.9 feet. An increase in cohesion with depth precludes deep soil slides and is an argument for parallel slope retreat as a result of weathering.—*from* Authors' conclusions

04688 **Lowenstam, H. A.** Paleotemperatury permskogo i melovogo periodov, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 132–152, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

Ludwig, William J. *See* Ewing, John. 04669

04981 **Luebs, R. E.; Brown, M. J.; Laag, A. E.** Determining water content of different soils by the neutron method: Soil Sci., v. 106, no. 3, p. 207–212, illus., tables, 1968.

The neutron scattering method for measuring soil-water content has been used extensively. Its wide acceptance results from the greater precision and rapidity of measurement than is possible with the gravimetric method. Accurate determination of soil-water content requires a knowledge of the soil bulk density including changes with depth of measurement. A change in a soil bulk density of O.2g/cc markedly affects the neutron meter calibration curve.—JWH

Luedke, R. G. *See* Fischer, R. P. 04773

05116 **Luedke, Robert G.; Burbank, Wilbur S.** Volcanism and cauldron development in the western San Juan Mountains, Colorado, *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 175–208, illus., tables, 1968.

Three major episodes of volcanism during middle (?) Tertiary time formed a layered succession of calc-alkalic eruptive materials nearly 1.5 m thick and having a volume greater than 1,000 cu mi in the western San Juan Mountains. In the first episode, eruption of several hundred cu mi of tuff breccia and subordinate lavas was followed by subsidence that created the San Juan volcanic depression, about 15 mi wide and 30 mi long. During the second episode, pyroclastic rocks and lava flows accumulated within this depression and on its borders, and the depression subsided farther. During the third episode, ash flows spread widely from centers within the depression; their eruption resulted in formation and subsidence of the nearly circular, perhaps comagmatic, Silverton and Lake City cauldrons within the earlier depression.—*from* Authors' abstract

05039 **Lutton, R. J.** Comparison of strengths of dense and vesicular types of basalt: Assoc. Eng. Geologists Bull., v. 5, no. 1, p. 1–11, illus., 1968.

Laboratory strength test results on basalt have accumulated in the course of geologic and engineering properties investigations for cratering experiments [in Nevada]. These data allow an analysis of the effect on properties of high porosity, in the form of vesicles. Two unexpected characteristics of highly vesicular basalt are: a reduced unconfined compressive strength far short of that predicted if the reduction of solid cross-sectional area were the only factor involved; and a leveling off or even a decrease in differential stress at great and greater confining pressure. In the first stress increases greatly in converging through vesicle partitions; thus strength is exceeded there, and this leads to rapid progressive failure. In the second confining pressure is not transmitted to some vesicle partitions and these fail more like small unconfined compression samples.—*from* Author's abstract

04754 **Lutts, A.** Determination of lattice parameters by the Kossel and divergent X-ray beam techniques, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 345–358, illus., 1968.

The aim of this article is to develop a general relationship and show how it can be used to determine, with a high degree of precision, lattice parameters of tetragonal and hexagonal as well as cubic crystals. The development of the general relationship is preceded by a brief historical review, a discussion of the relative merits of the methods, a short description of the nature of the diffraction patterns, and the

geometrical conditions necessary for realizing precision parameter measurements. In conclusion, the advantages and disadvantages of the Kossel and divergent-beam methods compared with those of the classical powder techniques are enumerated and discussed.—*from* Author's abstract

04778 **Luzier, J. E.; Bingham, J. W.; Burt, R. J.; Barker, R. A.** Ground-water survey, Odessa-Lind area, Washington: Washington Dept. Water Resources Water-Supply Bull. 36, 31 p., illus. [1968].

Since 1963 there has been a continuing increase in ground-water use in the Odessa-Lind area, largely for irrigation of wheat. The ground water, part of a large system that covers much of east-central Washington, moves slowly downgradient toward the southwest and toward the Columbia and Snake Rivers; nearly all is derived from precipitation and contained within layered basalt rocks. If pumping continues to increase, the water-level decline will accelerate over an area of ever-increasing size. Recommendations are to monitor pumpage and response of the ground-water system, amplify present knowledge of geologic controls, and develop a mathematical model of the system.—MCM

04886 **Macintyre, Ian G.** Preliminary mapping of the insular shelf off the west coast of Barbados, W. I.: Caribbean Jour. Sci., v. 8, nos. 1-2, p. 95-100, illus., 1968.

A rapid reconnaissance was made of the narrow insular shelf off the west coast of Barbados, W. I., with the aid of a sea sled and aerial photographs. Four distinct areas noted on the shelf are, in order of increasing depth: fringe reefs; a belt of sand; a distinct band of dead coral rubble; and a deeper area of prolific coral growth. Most of the insular shelf is an erosional terrace that was probably eroded in the last 7,000 to 8,000 years. [Fringe reefs are generally poorly developed and probably have only recently interfered with the erosional processes.]—Author's abstract

Mackay, Sherman. *See* Campbell, David G. 04849

05156 **MacKevett, E. M., Jr.; Smith, James G.** Distribution of gold, copper, and some other metals in the McCarthy B-4 and B-5 quadrangles, Alaska: U.S. Geol. Survey Circ. 604, 25 p., illus., tables, 1968.

The main mineral commodities in the McCarthy B-4 and B-5 quadrangles, eastern Alaska, include copper, gold, silver, antimony, molybdenum, and arsenic. Analyses of stream-sediment and rock samples, and related geologic investigations, provide data on the metal contents of the previously known deposits, of several newly found deposits, of stream-sediment samples, and of many of the rocks and altered zones. Some of the newly found deposits probably merit more thorough examinations.—Authors' abstract

Mackey, Harris L. *See* Winslow, John D. 04780

04713 **MacLaren, A. S.; Charbonneau, Brian W.** Characteristics of magnetic data on major subdivisions of the Canadian Shield [with French abs.]: Geol. Assoc. Canada Proc., v. 19, p. 57-65, illus., 1968.

An aeromagnetic anomaly map containing most of the presently available data over the Canadian Shield and adjacent areas is presented. The magnetic expressions of portions of the Grenville-Superior, Superior-Churchill, and Churchill-Slave metamorphic 'fronts' within the area of compilation are compared with each other and with the Moose River magnetic belt which lies wholly within the Superior structural province.—*from* Authors' abstract

04590 **Maddock, Thomas, Jr.** Discussion of 'Similitude theory applied to correlation of flume sediment transpoort data' by D. I. H. Barr and J. G. Herbertson [1968]: Water Resources Research, v. 4, no. 5, p. 1148-1149, 1968.

Barr and Herbertson (ibid., no. 2, p. 307-315) appear to say that their prooposed approach to analysis of sediment transport data is not supported by existing data, so additional experiments should be performed in hopes of finding data that will fit. Of all the equations they present, only one is wholly acceptable for reasons

presented by Maddock. There is nothing wrong with the great mass of data collected inn the study of flow of water in flumes with movable beds; what is wanting is a system of analysis that will take into account mutual interdependence of variables, particularly the effect of changing bed forms.—ESL

04800 **Mahtab, M. A.; Goodman, R. E.** Stresses around wellbores in nonlinear rock: Soc. Petroleum Engineers Jour., v. 8, no. 3, p. 304–312, illus., tables, 1968.

The state of stress around a vertical wellbore in rock following nonlinear stress–strain laws is examined by finite element analysis; the wellbore is considered an axisymmetric body with axisymmetric loading. Initial vertical and horizontal stresses are "locked" in the rock elements around the bore and a new state of stress is generated by displacements around the bore. The effect of nonlinearity on stresses is examined for a 6,000-ft wellbore in a schistose gneiss and Berea sandstone using results of laboratory triaxial compression tests. Results show that the effect is restricted to one well radius from the bottom periphery of the hole. Beyond one-quarter radius, the effect is almost always less than 5 percent. Static pressure inside the well does not magnify the effect of nonlinearity on borehole stresses.—*from* Authors' abstract

Major, Robert L. *See* Risser, Hubert E. 04799

04656 **Malahoff, Alexander; Woollard, George P.** Magnetic and tectonic trends over the Hawaiian ridge, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 241–276, illus., table, 1968.

Magnetic anomalies over the basaltic Hawaiian ridge are in the form of elongated dipoles above the dike-intruded composite plugs of individual volcanic centers. Their alignment parallels either the Molokai or Murray fracture zones or the strike of the ridge. Volcanism and the development of seamounts and ridges apparently occurred at the intersection of two tectonic systems.—MS

05131 **Manchee, E. B.; Weichert, D. H.** Epicentral uncertainties and detection probabilities from the Yellowknife seismic array data: Seismol. Soc. America Bull., v. 58, no. 5, p. 1359–1377, illus., tables, 1968.

A description is given of a computer method for automatic detection of seismic events and extraction of location and magnitude information from analog data collected by the Yellowknife array. The method yields a 50 percent detection level of m4.0±0.1 if instrumentation is well adjusted and background noise is not above average; this is an improvement of m0.4 over the detection ability with human assistance. One problem limiting the level of detection is that of transient electronic noise on one or more of the FM channels. Experiments to determine the accuracy of the computer-array epicenter determination have revealed marked deviations in arrival vectors from those expected from USCGS locations, both in azimuth and in apparent velocity as predicted by the J-B tables. Their distribution does not suggest a simple crustal or upper mantle cause under the array statioons.—DBV

04790 **Mandra, York T.** Silicoflagellates from the Cretaceous, Eocene, and Miocene of California, U.S.A.: California Acad. Sci. Proc., v. 36, no. 9, p. 231–277, illus., tables, 1968.a

This is a stratigraphic analysis and systematic catalog of silicoflagellates ranging from Maestrichtian to Delmontian (uppermost Miocene) in age, from nine localities in central and southern California. Thirty-four species and subspecies in eight genera are described and illustrated by 83 figures. Faunules are analyzed statistically (binomial distribution, expected frequency), slide uniformity and horizon uniformity having been demonstrated. It is concluded that silicoflagellates at the generic and specific level have value as a stratigraphic correlation tool. Tentative index taxa are listed for Maestrichtian, Upper Eocene, and the Relizian, Mohnian, and Delmontian stages of the Miocene.—VMJ

04664 **Manghnani, Murli; Woollard, George P.** Elastic wave velocities in Hawaiian rocks at pressures to ten kilobars, *in* The crust and upper mantle of the Pacific

area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 501-516, illus., tables, 1968.

In addition to new data on the significant role of olivine in influencing the velocities of basalts, new values are derived for porosity and elastic moduli on the basis of laboratory investigations of some 165 specimens of Hawaiian basalts and basic inclusions, with a view to their importance for interpreting the probable composition of various velocity layers of the Earth's crust and upper mantle from seismologic data.—MS

Mankin, Charles J. *See* Kerns, Raymond L., Jr. 05092

04716 **Mannard, G. W.** The surface expression of kimberlite pipes [with French abs.]: Geol. Assoc. Canada Proc., v. 19, p. 15-21, illus., 1968.

This paper describes the surface expression of kimberlite pipes, particularly features which may assist in their discovery in overburden-covered areas. Kimberlite occurs as clusters of dikes and pipes in cratonic areas. The pipes range from a few tens of feet to nearly a mile in diameter and exhibit a wide variety of shapes; even in nonglaciated regions, topography, soil, and vegetation rarely indicate the presence of kimberlite. Photogeology and geophysical techniques are useful mainly in outlining known pipes or finding adjacent pipes. The most diagnostic surface evidence of kimberlite is the presence in residual soil or alluvium, of certain heavy accessory minerals; magnesian ilmenite, chromian pyrope-almandine garnet, and chrome diopside are the most useful. Some applications of the heavy mineral technique are described.—*from* Author's abstract

05081 **Mansell, Robert S.; Nielsen, Donald R.; Kirkham, Don.** A method for simultaneous control of aeration and unsaturated water movement in laboratory soil columns: Soil Sci., v. 106, no. 2, p. 114-121, illus., 1968.

A method has been devised whereby a gas may be circulated through water-unsaturated soil which has water moving through it at a constant flux. Water within the pores of the unsaturated soil, being at subatmospheric pressure and in thin films, allows the oxygen gas to readily diffuse and exchange with that dissolved in the soil water. Adaptations could easily be made for such studies as biodegradation of surface-applied organic waters, replenishment of soil oxygen during plant growth, and residence times of a biocide in aerated soils.—JWH

Mansinha, L. *See* Smylie, D. E. 05005

04734 **Marques, J. M.; Scott, A. D.** Preparation of sodium-degraded mica: Clays and Clay Minerals, v. 16, no. 4, p. 321-322, illus., table, 1968.

Interest in mica weathering and in exchangeability of interlayer cations in micaceous minerals with high layer charge has created a need for K-depleted mica samples. Large samples of <50μ biotite and muscovite were K-depleted by a method reported earlier. The resultant NH_4-degraded mica was subjected to various treatments for removal of NH_4, and results obtained by the steam distillation method are reported. Biotite has a higher rate of release with fixed interlayer NH_4 relative to muscovite, but complete removal was attained with both. An exchange of Na for most of the K and all the NH_4 was attained with no more change in layer charge than anticipated for the K-depletion step.—ESL

Marvin, Richard F. *See* Dickinson, Robert G. 05157

Mason, W. J. *See* Hendricks, R. W. 04573

04860 **Matalucci, Rudolph V.; Abdel-Hady, Mohamed.** Infrared aerial surveys in environmental engineering: Am. Soc. Civil Engineers Proc., v. 94, paper 6277, Jour. Sanitary Eng. Div., no. SA 6, p. 1071-1084, illus., 1968.

Infrared radiation can be considered one of the most useful regions of the electromagnetic spectrum for remote sensing. All natural objects above absolute zero emit IR radiation, and in addition absorb or reflect it. Some basic differences

between IR photography and imagery are analyzed, and basic principles are reviewed and illustrated. Since the energy level and wavelength are usually unique for some substances, an identification technique can be developed. Aerial IR radiation surveys have been applied successfully to water pollution control, and their potential application for detecting air pollution is promising. The use of IR imagery to display stream valleys and subsurface drainage patterns is illustrated.—ESL

04579 **Mavis, Frederic T.** Graphical statistics and common-sense applications: Am. Soc. Civil Engineers Proc., v. 94, paper 6108, Jour. Hydraulics Div., no. HY5, p. 1207-1216, illus., table, 1968.

Analogs in statistics and mechanics can give the engineer a commonsense meaning of arithmetic means, standard deviations, and lines of mutual regression by least squares. Even so, numbers often have less vivid impact than graphs in the interpretation and projection of data which vary. Examples show how data can be analyzed graphically using medians and quartile deviations as measures of averages and variations. Such graphical methods lead to inferences equally valid and usually more meaningful than corresponding numbers arrived at by the method of least squares. A scale of probable deviations is presented in terms of percentage frequency and quartile deviations which, for normal distributions, leads graphically to the same probability estimates as those derived numerically by least squares, less abstractly and in less time. A list of papers on probability and statistics from 1901 through 1950 is appended.—Author's abstract

Mays, R. E. *See* Dodge, F. C. W. 04812

McAtee, James L., Jr. *See* Warren, Doris C. 04741

05031 **McConnell, R. K., Jr.; Simon, Ivan.** *In situ* stress measurements from tilts induced by mining operations: Soc. Mining Engineers Trans., v. 241, no. 3, p. 311-313, illus., 1968.

In anticipation of the production of rugged, sensitive tiltmeters small enough for use in boreholes, the possibility is considered of using such instruments in a drill hole prior to mining operations to determine the *in situ* stress distribution before and after mining operations. Calculations are given to show the ultimate sensitivity in radians and the range of radians necessary in a tiltmeter to determine a given range of stresses.—VSN

McCoy, Floyd W., Jr. *See* Stice, Gary D. 05163

05048 **McEvilly, T. V.** Seafloor mechanics north of Cape Mendocino, California: Nature, v. 220, no. 5170, p. 901-903, illus., 1968.

New seismological evidence on ocean-floor tectonics off northern California and Oregon makes somewhat clearer the mechanics of deformation at the complex intersection of the oceanic Mendocino-Gorda escarpments and the continental San Andreas fault, and sheds light on the general question of deformation at places where spreading oceanic ridges reach continents.—DBV

McGinnis, H. *See* Camp, C. L. 04817

McGovern, Harold E. *See* Winslow, John D. 04780

04682 **McKee, E. D.** Raspoznavaniye zharkikh i aridnykh klimatov proshlogo, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 229-240, illus., table, 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7-12, 1963.—DBV

McKee, Edwin H. *See* Wolfe, Edward W. 04889

04983 **McQueen, Irel S.; Miller, Reuben F.** Calibration and evaluation of a wide-range gravimetric method for measuring moisture stress: Soil Sci., v. 106, no. 3, p. 225-231, illus., tables, 1968.

The filter paper method as an indirect gravimetric moisture stress sensor is versatile, accurate, convenient, and economical. It is effective over the entire stress range from 0.01 to 1,500 bars, from 1 to 1,500,000 cm of water. Moisture stress determined by the filter paper method may have an accuracy that is comparable or better than the accuracy of other methods with limited ranges.—JWH

05107 **Meinschein, W. G.; Sternberg, Yaron M.; Klusman, Ronald W.** Origins of natural gas and petroleum: Nature, v. 220, no. 5173, p. 1185–1189, illus., tables, 1968.

Crude oils seem to be products of sequential processes which began with the isolation of natural gases by frontal analyses of ground water solutions of the gaseous constituents of sedimentary rocks. Certain gases, thus formed, then dissolved other organic constituents from the sedimentary rocks through which the gases moved. Consequences of such solution and movement of organic compounds as solutes in natural gases are: (1) a chromatographic fractionation similar to the frontal analyses; (2) an increase in solubilities of high molecular weight hydrocarbons in the gas solutions; and (3) the eventual establishment of gaseous and liquid hydrocarbon phases.—DBV

05010 **Mellary, A. A.; Jeffs, D. N.** Aquifer test in a sand plain at Bothwell, Ontario [with French abs.]: Geol. Assoc. Canada Proc., v. 19, p. 66–78, illus., tables, 1968.

In a shallow sand and gravel aquifer, tested at Bothwell, one pumping well and 8 observation wells were drilled 2 miles north of the Thames River. Analysis of pumping data was complicated by three factors: the aquifer was unconfined, the water table was sloping, and the aquifer was partially screened. Calculated adjustments for dewatering the aquifer gave small changes in coefficients of transmissibility and storage. Observation wells were at distances from the pumped well greater than twice saturated thickness of the aquifer, and adjustments for partial penetration gave further small changes in coefficient of storage; no correction was made for the sloping water table. Adjusted coefficients were: coefficient of transmissibility, 6,900 gpd per ft; coefficient of storage, 0.054. During recovery the low area in the residual cone of depression shifted gradually in the downslope direction of the original water table.—*from* Authors' abstract

Miller, Reuben F. *See* McQueen, Irel S. 04983

04870 **Milliman, John D.; Emery, K. O.** Sea levels during the past 35,000 years: Science, v. 162, no. 3858, p. 1121–1123, illus., 1968.

A sea-level curve of the past 35,000 years for the Atlantic continental shelf of the United States is based on more than 80 radiocarbon dates, 15 of which are older than 15,000 years. Materials include shallow-water mollusks, oolites, coralline algae, beachrock, and salt-marsh peat. Sea level 30,000 to 35,000 years ago was near the present one. Subsequent glacier growth lowered sea level to about −130 m 16,000 years ago. Holocene transgression probably began about 14,000 years ago, and continued rapidly to about 7,000 years ago. Dates from most shelves of the world agree with this curve, suggesting that it is approximately the eustatic curve for the period.—Authors' abstract

Milne, W. G. *See* White, W. R. H. 04670

Misra, S. B. *See* Anderson, M. M. 05047

04747 **Mitchell, Betty J.** Applications of computerized statistical techniques in quantitative analysis, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 129–149, illus., tables, 1968.

This paper describes advantages and disadvantages of various computer systems for the X-ray spectrographer, and numerous statistical techniques which he may employ.

Statistics provide him with tools to design experiments, interpret data, control the process which supplies samples, improve sampling procedures, calibrate X-ray equipment, perform theoretical studies, and calculate, correct, average, and evaluate analyses. Digital computation provides him with an extraordinarily rapid means of making these calculations. Examples of analyses are described which are made practicable only by this combined statistical computerized approach. Accuracy and precision of computerized analyses are higher than for results obtained by the usual X-ray methods. The X-ray laboratory presents an outstanding example of the need for statistical analysis and its associated digital-computer computation.—*from* Author's abstract

04890 **Mitchell, Richard S.; Geitgey, Ronald P.** Barian florencite, weinschenkite, and rhabdophane from a perrierite-bearing pegmatite in Amherst County, Virginia: Southeastern Geology, v. 9, no. 3, p. 143–150, tables, 1968.

Analyses of crusts and seams associated with materials in a deeply weathered perrierite-bearing pegmatite in Amherst County, Virginia, have shown the presence of the rare-earth phosphates barian florencite, weinschenkite, and rhabdophane. Spectrochemical and indexed X-ray diffraction data are given for barian florencite and weinschenkite. Other minerals in the deposit include perrierite, apatite, zircon, magnetite, ilmenite, quartz, microcline, biotite, anatase (after perrierite), lithiophorite and cerianite(?).—Authors' abstract

04672 **Miyamura, Setumi.** Seismicity of island arcs and other arc tectonic regions of the circum-Pacific zone, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 60–69, illus., tables, 1968.

Magnitude-frequency relations revealed by statistical analysis of computerized data on the preliminary determinations of earthquake epicenters show a correlation with tectonic ages of the various regions. The data indicate the existence of a common aseismic transient layer at a depth of 300–450 km between deep and intermediate earthquake layers and that shallow earthquakes, probably crustal, of western Canada, western United States, and southern Chile suggest block movement of ancient arcuate structures, whereas shallow earthquakes of the southeastern Pacific region are mantle earthquakes.—MS

04721 **Molina Berbeyer, Rafael.** Determinación químico-analítica de estroncio y rubidio para el cálculo de edades geológicas (en los minerales lepidolita muscovita, biotita y feldespato-potásico contenidos en las rocas): Soc. Quím. México Rev., v. 12, no. 3, p. 110A–112A, 1968.

An isotope dilution technique for Rb-sr age determinations is described in which Rb is precipitated as the perchlorate and Sr is separated by ion exchange and evaporated to dryness. The solids are then applied to a tantalum filament for mass spectroscopy. The equations used and the special precautions required are discussed.

Molinski, Victor J. *See* Kramer, Henry H. 04706

05149 **Mongin, Denise.** Les Pectinides du Miocene de la Guadeloupe (Antilles francaises) [with English abs.]: Bulls. Am. Paleontology, v. 54, no. 245, p. 471–510, illus., tables, 1968.

Fifteen species of Pectinidae from the Miocene of Guadeloupe Island, described and illustrated, belong to the classical Miocene fauna of the Caribbean region, most of which are common in Miocene rocks of Jamaica and Santo Domingo. The affinities decrease with those of Anguilla, Costa Rica, Panama, and Cuba. Common species are scarce with the Miocene of Central America and the United States. Stratigraphically, the Miocene beds could belong to the Burdigalian, for some parts, and chiefly the middle Miocene (Helvetian), and a few beds represent upper Miocene. The most abundant species are *Pecten ventonensis* and *Plagioctenium uselmae*.—*from* Author's abstract

04775 **Monroe, Watson H.** The Aguada Limestone of northwestern Puerto Rico: U.S. Geol. Survey Bull. 1274-G, p. G1–G12, illus., 1968.

Geologic mapping in 1966 and 1967 has shown that the strata exposed in the area near Aguada, chosen as the type area of the Aguada Limestone, are a westward extension of strata probably belonging to the Cibao Formation that underlies the Aguada Limestone. The closest outcrops of limestone equivalent to the Aguada Limestone as mapped elsewhere in Puerto Rico are approximately 5 km northeast of Aguada. As the name Aguada is firmly entrenched in the geologic literature for the limestone beds between the Cibao Formation and the Aymamón Limestone, the name Aguada Limestone is retained, but a special reference section is designated on Highway 110, 2 to 3 km north of Moca. The new reference section is about 9 km northeast of Aguada.—Author's abstract

04620 **Moorhouse, W. W.** Memorial to Elwood S. Moore (1878–1966): Geol. Soc. America Proc. 1966, p. 317–323, portrait, 1968.

04739 **Moorhouse, W. W.** Elwood S. Moore, 1878–1966: Royal Soc. Canada Minutes Proc., 4th ser., v. 6, p. 161–165, portrait, 1968.

Morales-Alamo, Reinaldo. *See* Haven, Dexter S. 04990

04627 **Morley, Harold T.** Memorial to Robert Jennings Riggs (1888–1965): Geol. Soc. America Proc. 1966, p. 353–355, portrait, 1968.

Mosher, Robert E. *See* Sanford, John T. 04719

05018 **Mound, Michael C.** Conodonts and biostratigraphy of the lower Arbuckle Group (Ordovician), Arbuckle Mountains, Oklahoma: Micropaleontology, v. 14, no. 4, p. 393–434, illus., tables, 1968.

Lower Arbuckle Group strata (McKenzie Hill and Cool Creek Formations) have yielded a moderately large conodont fauna of over 2,000 identifiable specimens. The various elements have been assigned to 55 species, 4 of them new, distributed among 17 genera. McKenzie Hill conodonts show no dominant group but contain an assortment of species while Cool Creek conodonts are dominated by an overwhelming number (>60 percent of the total lower Arbuckle fauna) of specimens of *Scolopodus*. These include, in order of importance, *Scolopodus quadraplicatus* Branson and Mehl, *S. triangularis* Ethington and Clark, *S. triplicatus* Ethington and Clark, and *S. filosus* Ethington and Clark. The Cool Creek may correlate in part with the El Paso Formation of west Texas.—*from* Author's abstract

05089 **Moxey, R. L.** Gli impianti geotermici californiani: Industria Mineraria, ser. 2, v. 19, no. 8, p. 440–447, illus., 1968.

The Geysers power plant of the Pacific Gas and Electric Co., north of San Francisco, Calif., generates electric power (26,000 kw at present) from geothermal steam of The Geysers area. Operations and development stages of the plant are described. Theories of geologic origin of the natural steam, exploration history, well drilling, and estimated reserves are summarized. A brief inventory is given of geothermal resources in other areas of California and in other countries including Italy and New Zealand.—VMJ

04869 **Murthy, V. Rama; Beiser, E.** Strontium isotopes in ocean water and marine sediments: Geochim. et Cosmochim. Acta, v. 32, no. 10, p. 1121–1126, illus., tables, 1968.

The isotopic composition of Sr in the major oceans of the world is uniform at the present time; the average Sr-87/Sr-86 ratio is 0.7094 ± 0.0012 at the 95 percent confidence level. The clay fractions of the equatorial Atlantic deep-sea sediments contain Sr of variable composition, not in isotopic equilibrium with ocean water. The Sr composition in the sediments is related to provenance and clay mineralogy.—Authors' abstract

04594 **Nace, Raymond L.** Memorial to Radcliffe Harold Beckwith (1900–1964): Geol. Soc. America Proc. 1966, p. 169–174, portrait, 1968.

04640 **Nafe, John E.; Drake, Charles L.** Physical properties of rocks of basaltic composition, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 2 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 483–502, illus., table, 1968.

Typical ranges of values of elastic and other properties of gabbro, norite, diabase, dolerite, basalt, and basaltic glass are derived with reference to their dependence on pressure, temperature, or composition and to the differences between rocks of the basalt–gabbro clan and granites. These properties determined primarily by composition are discussed in particular.—MS

Nafe, John E. *See* Drake, Charles L. 04665

04686 **Nairn, A. E. M.** Dannyye o paleomagnitnykh shirotakh permskikh perioda, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 346–356, illus., tables, 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

05036 **Naldrett, A. J.; Kullerud, G.** Emplacement of ore at the Strathcona mine, Sudbury, Canada, as a sulife–oxide magma in suspension in young noritic intrusions, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 7, Endogenous ore deposits: Prague, Academia, p. 197–213, illus., 1968.

Evidence from a recent study of the Strathcona ore body in the Sudbury area, indicates that the sulfides are magmatic and are associated with noritic intrusions younger than the main body of the Sudbury Nickel Irruptive. It is concluded that the pyrrhotite–pentlandite–chalcopyrite ore was introduced largely with xenolithic norite and to a lesser extent with the mafic norite, and that the sulfides were carried up as droplets of immiscible sulfide–oxide liquid suspended in the silicate magma. New experimental work on the Fe–S–O system in the dry state, in the presence of water, and with small amounts of Ni and Cu added to the system indicate that the sulfide–oxide liquid is likely to have started crystallizing just above 1,100°C and to have solidified at about 1,040°C. The solidus temperature of the ore is therefore probably 50 to 100°C higher than the solidus temperature of the noritic host rocks.—*from* Authors' abstract

Naughton, John J. *See* Finlayson, J. Bruce. 04660

04861 **Nelson, Clifford M.** Ammonites—Ammon's horns into cephalopods: Soc. Bibliography Nat. History Jour., v. 5, pt. 1, p. 1–18, 1968.

Ammonites, or ammonoids, have been associated with necromancy, myths, legends, and history since late Paleolithic times. Their name was derived from the resemblance of the crenulated whorls of these fossils to the ram's horns sacred to the Egyptian deity Amun; the "...ites" suffix is a remnant of ideas concerning the nonorganic nature of fossils, added to the names of objects which were thought not to be actual remains of the living organisms or their parts which they resemble. The real nature of fossils continued to be under heated debate even into the 18th century. A brief historical survey of study and development of ammonoid systematics to the beginning of the fractionation of genus *Ammonites* in 1865 makes little mention of many 19th century contributions. Subsequent taxonomic developments are so numerous, complex, and sometimes bewildering that they, with all post-Linnaean systematics, require a separate paper.—GDC

Nelson, Willis H. *See* Pierce, William G. 04767

Newman, Walter S. *See* Fairbridge, Rhodes W. 04836

Newton, R. C. *See* Ganguly, J. 05090

Nichols, R. H. *See* Camp, C. L. 04817

Nielsen, Donald R. *See* Mansell, Robert S. 05081

04998 **Niini, Aarno.** The movement of the continent of America—Facts and assumptions: Acad. Sci. Fennicae Annales, ser. A–3, no. 95, 21 p., illus., 1968.

It is suggested that the continents of America, Antarctica, Australia, and Asia moved to their present places suddenly in a tremendous revolution in the early Tertiary, when Circumpacific Alps arose around the area where the crust vanished from the Earth's mantle; thus the ocean floor is as young as the Circumpacific Alps. The Rocky Mts. and Andes were once on top of the Mid-Atlantic Ridge, forming part of a consistent ring around the almost untouched preserved part of the Earth's surface, the "aboriginal continent." The Mid-Atlantic Ridge is a remnant of the deepest roots of these Alps at the site of their inner boundary before the continents glided over them. The major revolution could only have been due to the very close approach of the Moon, a twin planet which came within Roche's limit and collided with the Earth in the area of the present Pacific, then rebounded and became a satellite.—DBV

Nishikawa, M. *See* Kushiro, I. 05058

04989 **Nishita, H.; Hamilton, M.** Some thermoluminescent characteristics of gamma irradiated soils: Soil Sci., v. 106, no. 3, p. 76–84, illus., tables, 1968.

Soils irradiated to 1,000R with Co60 gamma rays showed a wide range of thermoluminescence. The maximum peak heights generallyy occurred in one or several of the following temperatures: around 159°C, 285°C to 295°C, and 350°C to 375°C. Vermiculite, kaolinite, bentonite, illite, bauxite, and nine different salts showed a wide range of thermoluminescence. The decay of thermoluminescence was rapid during the first 24 hours; it was slower between 24 and 672 hours, and then became quite slow. About 1.5 percent loss occurred between 672 to 2,160 hours.—JWH

Nixon, D. D. *See* Voloshin, V. 05041

Nobeli, Catherine. *See* Yassoglou, N. J. 04819

04597 **Nolan, Thomas B.** Memorial to Thomas Monteith Broderick (1899–1965): Geol. Soc. America Proc. 1966, p. 183–186, portrait, 1968.

04603 **Nolan, Thomas B.** Memorial to Henry Gardiner Ferguson (1882–1966): Geol. Soc. America Proc. 1966, p. 215–219, portrait, 1968.

05164 **Nordin, Carl F.; Richardson, Everett V.** Statistical descriptions of sand waves from streambed profiles: Internat. Assoc. Sci. Hydrology Bull., v. 13, no. 3, p. 25–32, illus., 1968.

Profiles of rippled or dune-covered beds rarely exhibit a simple dune form, but a great variety in size and shape; mean values of lengths, heights, and angles are only crude representations. Some techniques are summarized for describing their statistical properties, recently developed from records of bed profiles obtained with new sonic equipment which is portable and accurate for laboratory or field use. Bed elevations appear to follow a Gaussian distribution, amplitudes are distributed exponentially, and standard deviation of bed elevation agrees well with average amplitude. Mean duration of an upward excursion of the process above a fixed level is the mean rest period of a particle buried at that level. This important parameter in stochastic models of sediment transport can be determined empirically from records of the process, indicating that mean values of the rest periods can be estimated theoretically from fairly simple models.—GDC

04576 **Nordin, Carl F., Jr.; Algert, James H.** Spectral analysis of sand waves—Closure [to discussion of paper 4910, 1966]: Am. Soc. Civil Engineers Proc., v. 94, paper 6087, Jour. Hydraulics Div., no. HY5, p. 1336–1338, 1968.

A method for relating space and time records was developed recently, but its applicability to field data has not been established. For laboratory data, expressing

the spectra in dimensionless form permitted expression for the wave number and the frequency spectra in simple equations, allowing conversion from one type to the other. The technique described by Plate for determining a true average wave form is interesting but does not show any advantages over simpler methods. Evidence indicates that when ripples first form they are more regular and two dimensional than after flow has persisted, and Plates's method may be applicable here.—ESL

Norris, Roger A. *See* Johnson, Rockne H. 04673

04760 **Norvitch, Ralph F.; Farrell, Donald F.; Pauszek, Felix H.; Petersen, Richard G.** Hydrology and water resources of the Housatonic River basin, Massachusetts: U.S. Geol. Survey Hydrol. Inv. Atlas HA-281, 4 sheets, various scales, text, 1968.

Sheet 1 contains information on physical setting, climate, water budget, and water use; sheet 2, surface water; sheet 3, quality of water; and sheet 4, geology and ground water. An average of 26 mgd was used in the basin in 1964, of which 36 percent was from ground water; present water systems are being taxed to capacity. Because chemical and physical properties of the rocks vary widely, quality of ground water varies from place to place; this data is summarized in tables. Large supplies of ground water are available at several places within the valley; water is generally soft and of excellent quality for domestic and industrial use. Stratified surficial deposits are considered the best aquifer (range from less than 1 to 900 gpm); median bedrock yields range from 5 to 20 gpm.—MCM

04784 **O'Brien, Neal R.** Electron microscope study of black shale fabric: Naturwissenschaften, v. 55, no. 10, p. 490–491, illus., 1968.

The black roof shale of the Pennsylvanian Harrisburg Coal in Illinois was selected for study because of its highly fissile character, and because X-ray and geochemical data have been published. An electron micrograph indicates the high degree of parallelism of the illite clay flakes suggested by X-ray. No random flake orientation was found. Organic material appears to be so finely disseminated as to be unresolved by the electron microscope, and may be present as adsorbed molecules. The highly organic nature of the shale indicates that it may have been deposited in the dispersed state.—ESL

Okano, Hiroshi. *See* Tomura, Teruichi. 04750

Olsen, David A. *See* Holland, Charles T. 05032

04982 **Ong, H. Ling; Bisque, R. E.** Coagulation of humic colloids by metal ions: Soil Sci., v. 106, no. 3, p. 220–224, tables, 1968.

Coagulation studies involving the alkali soluble fraction of peat with added monovalent ions (Li, Na, and K), divalent ions (Mg and Ca), and trivalent ions (Fe, Al, and Ce) demonstrated the following: (1) the amount of monovalent, divalent, and trivalent ions required to effect coagulation generally agrees with the ratio of 1:0.016:0.0014; and (2) for the monovalent or divalent ions, the coagulating power increases as the radius of the hydrated ion decreases. The colloid coagulation process may be responsible for much of the metal transport in podzolization.—JWH

04740 **Osborne, F. Fitz.** J.-Willie Laverdière, 1897–1967: Royal Soc. Canada Minutes Proc., 4th ser., v. 6, p. 137–141, portrait, 1968.

04759 **Osterkamp, W. R.** Occurrence of ground water in the Judith River Formation, north-central Montana: U.S. Geol. Survey Hydrol. Inv. Atlas HA-308, scale 1:250,000, sections, text, 1968.

In this map area formations pertinent to the Judith River Formation as an aquifer are, in descending order, the Bearpaw Shale, Judith River, and Claggett Shale, all late Cretaceous, and with the underlying Eagle Sandstone, constitute the Montana Group. Principal structural feature is the Blood Creek syncline, a broad asymmetric trough about 80 miles wide plunging approximately 20 feet per mile ESE, and terminating in the west in a zone of intense faulting. The Judith River is saturated

with artesian or confined ground water which can be obtained mainly by pumping. Resources south of the Missouri River are almost untapped and offer good prospects. Water from the aquifer is of acceptable quality for livestock, but marginal for domestic use.—MCM

Ovenshine, A. Thomas. *See* Pittman, Edward D. 04991

04818 **Overman, Allen R.** Convective diffusion in clay systems: Soil Sci. Soc. America Proc., v. 32, no. 5, p. 616–618, illus., tables, 1968.

The theory of convective diffusion has been applied to transport of salt through clay columns. An expression was derived for salt distribution within the column for steady state conditions. Data from the literature were used to test the applicability of the distribution function to clay systems. The observed nonlinearity is described to high precision by the equation. However some discrepancy occurs between calculated and measured parameters. The theory allows calculation of the relative transfer rates of salt by convection and diffusion.—Author's abstract

Ozawa, T. *See* Iwasaki, I. 04659

04887 **Page, Leo M.** Use of the electrical resistivity method for investigating geologic and hydrologic conditions in Santa Clara County, California: Ground Water, v. 6, no. 5, p. 31–40, illus., table, 1968.

The electrical resistivity method has been a valuable tool used in the discovery of ground-water recharge facilities with percolation capacities in excess of 100,000 acre-feet per year. The procedures used in doing the field work and the methods of plotting the data are described using a typical area where studies were made. Correlations of soil types, recharge rates, and resistivity data for Santa Clara County are included. Ground-water level data from observation wells are used to measure the regional and long-term effects of the ground-water recharge program.—Author's abstract

05051 **Pakiser, L. C.** Seismic evidence for the thickness of Cenozoic deposits in Mono Basin, California: Geol. Soc. America Bull., v. 79, no. 12, p. 1833–1838, illus., 1968.

In Mono Basin the thickness of Cenozoic deposits required to account for a 1.43-second delay in recorded seismic waves is estimated to be 5±1 km. The delay of seismic waves emerging in Long Valley was less than expected, indicating that they were propagated into Long Valley mainly through high-velocity rocks.—AG

04996 **Palmer, Harold.** East Pacific Rise and westward drift of North America: Nature, v. 220, no. 5165, p. 341–345, illus., 1968.

It is proposed that North America has drifted westward, intermittently, as a result of sea-floor spreading of the Mid-Atlantic Ridge. The first and most significant period of drift occurred between Middle Permian and Upper Cretaceous time. If a drift rate of 1.2 cm per yr is reasonable, the leading edge of North America would have reached the projected crest of the East Pacific Rise about 150 m.y. ago (Middle Jurassic): by the end of the initial spreading cycle (70 m.y. aggo) the continent had nearly reached its present position. A later period of drift, from 10 m.y. ago to the present, completed the drift so far. If the continent did advance over the East Pacific Rise, its passage should be marked by geotectonic effects on a grand scale; current studies in the far west of the United States continue to resolve a zone of thrust sheets and overturned folds directed to the west.—DBV

04770 **Palmer, James E.** Geologic map of the Nortonville quadrangle, Hopkins and Christian Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-762, scale 1:24,000, section, text, 1968.

Although coal has been mined in the Nortonville quadrangle for about 100 years, significant reserves remain. More than 65 wells have produced gas and about 45 are presently productive; about 25 wells are commercial producers of gas. Both structure and stratigraphy have been important factors in oil and gas accumulation.

Limestone beds of the Curlew Limestone Member locally attain a total thickness of about 15 feet where mapped in the southern part of the quadrangle.—MCM

Papike, J. J. *See* Dodge, F. C. W. 04812

04615 **Park, C. F., Jr.** Memorial to Roy Angus MacDiarmid (1933–1966): Geol. Soc. America Proc. 1966, p. 291–292, 1968.

04610 **Park,, Charles F., Jr.** Memorial to Adolph Knopf (1882–1966): Geol. Soc. America Proc. 1966, p. 261–266, portrait, 1968.

05095 **Parker, Ronald B.; Brunfelt, Arild O.** Precision and accuracy of sodium determination by neutron activation: Chem. Geology, v. 3, no. 3, p. 213–217, 1968.

Replicate analyses for sodium were performed on two rock powders in order to evaluate the precision and accuracy of instrumental reactor neutron activation analysis for sodium in common rock types. The suggested experimental methods should yield precision of about 1 percent or less relative deviation, together with good accuracy. The precision obtained is equal to or better than alternate methods.—Authors' summary

04801 **Patchen, Douglas G.** Keefer Sandstone gas development and potential in West Virginia: West Virginia Geol. and Econ. Survey Circ. 7, 14 p., illus., table, 1968.

Gas has been produced for many years from the Middle Silurian Keefer Sandstone (Big Six sand of the Driller) in eastern Kentucky and Wayne County, West Virginia. Early production in Wayne County was confined to the Whites Creek–Cragston Creek field, but in 1942 gas was found in the Keefer in the Herbert field (Wayne County). Development of this field has continued to the present. In 1959 Keefer gas was discovered in the Fort Gay–Hubbardstown field, south of this earlier production. Activity in Wayne County has fallen off since the peak period from 1959 to 1962, but recently operators have begun to drill wells deep enough to test the Keefer in areas with production from the Newburg sand (Upper Silurian) east of Wayne County in Putnam and Kanawha Counties.—Author's abstract

04987 **Patric, J. H.; Stephens, F. R.** Soil-moisture levels in some representative soils near Juneau, Alaska: Soil Sci., v. 106, no. 3, p. 172–176, illus., tables, 1968.

There was considerable variation in the water losses from soils at the various study sites and no real difference in soil-moisture loss from forested soils and clearcut soils. This result is different from most American forest literature which states that cutting forest vegetation always is followed by increased soil-water content. It is possible that the low vegetation of the clearcut soils removes moisture as efficiently as the forests in southeastern Alaska.—JWH

04711 **Pauli, F. W.** Some recent developments in biogeochemical research: Geol. Assoc. Canada Proc., v. 19, p. 45–49, 1968.

Theoretical biogeochemistry is concerned with primary causes for mobilization and transportation of elements from the uppermost lithosphere into the biosphere which includes the fresh water cycle. The presence of water as the most efficient solvent and its physico-chemical properties and biochemical activity are responsible for separation aed enrichment processes in the cycle. Even more effective in mobilization and transportation processes during weathering is the biosynthesis of chelating and sequestering agents. With increasing molecular weight, humic compounds, derived from decomposing organic residues and heterogeneous catalysis, acquire inclusion properties, thus arresting liberated mineral components in their structures. Their wide distribution, unique chemical configurations, and high dynamic behavior, render these biocolloids the most versatile agents in the terrestrial, freshwater, and probably, marine biocycle.—*from* Author's abstract

Pauszek, Felix H. *See* Norvitch, Ralph F. 04760

Peake, Nancy M. *See* Hall, John W. 05021

Pedersen, K. Raunsgaard. *See* Lam, Jörgen. 05023

Penfound, William T. *See* Collins, Vernes E. 05143

04833 **Pepin, Robert; Reynolds, John.** Craig Morris Merrihue, 1933–1965: Meteoritics, v. 4, no. 1, p. 1–6, portrait, 1968.

Petersen, Richard G. *See* Norvitch, Ralph F. 04760

04767 **Pierce, William G.; Nelson, Willis H.** Geologic map of the Pat O'Hara Mountain quadrangle, Park County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-755, scale 1:62,500, sections, 1968.

04872 **Pinchak, Alfred C.** Avalanche activity on the Vaughan Lewis Icefall, Alaska: Jour. Glaciology, v. 7, no. 51, p. 441–448, 1968.

Avalanche data were obtained by direct observations of the Vaughan Lewis Icefall. Magnitude, time and location of each ice fall were recorded and the resulting data were analyzed statistically. An inverse relationship was found between the relative frequency and the magnitude of the avalanches. A significant diurnal variation in avalanche rate was detected. During the early morning hours the avalanche rate reached a maximum. No secondary increase in the avalanche frequency was observed during the evening cooling period. The data indicated that a given ice fall results in an increased probability of the ice fall occurring shortly thereafter. After approximately 4 min the effect of a given avalanche no longer correlates with succeeding avalanches.—Author's abstract

04569 **Pinder, George F.; Bredehoeft, J. D.** Application of the digital computer for aquifer evaluation: Water Resources Research, v. 4, no. 5, p. 1069–1093, illus., 1968.

The unsteady-state flow of a fluid in a confined aquifer can be approximated by linear, parabolic, partial-differential equations. A digital-computer program was written to solve these equations based upon an implicit finite-difference technique. Calculated values compared favorably with analytical solutions for homogeneous, isotropic aquifers of simple geometry. An analysis of an aquifer at Musquodoboit Harbour, Nova Scotia, was made using this technique. Aquifer parameters in the digital model were modified until the results computed fitted the pump-test data. Results indicate that this aquifer would come to equilibrium in about 100 days and easily provide an adequate supply of water for the village. As a check of the digital model an analog of this aquifer was also constructed; the two solutions obtained compared favorably.—*from* Authors' abstract

04831 **Pipkin, Bernard W.** Analysis of wedge failures in layered rocks: Assoc. Eng. Geologists Bull., v. 5, no. 1, p. 12–17, illus., 1968.

Wedge failures are translations of small masses of rock along bedding planes oriented at an angle to the strike of an artificial or natural slope. Geologic cross sections drawn normal to such slopes usually portray a component of the true dip as imaginary planes dipping out of the slope. Geometric and kinematic analyses demonstrate that there is no justification a priori for using apparent dip as a design parameter for retaining structures or slope stability analyses. Nomographic solutions for the minimum setback necessary to place structures beyond the zone of wedge failure parallel to the top of cut slopes are presented.—Author's abstract

04991 **Pittman, Edward D.; Ovenshine, A. Thomas.** Pebble morphology in the Merced River (California): Sed. Geology, v. 2, no. 2, p. 125–140, illus., 1968.

Where minimum distance of granite pebble transport could be determined, modern alluvium was sampled for percentages of granite pebbles and broken rounds, roundness, and shape. Downstream from a large cataract are a paucity of intermediate-sized clasts, with many broken rounds, and a decrease in overall roundness. Intermediate-sized pebbles move through the cataract mainly by saltation, larger pebbles by traction, and smaller ones by suspension. The critical factor in breakage is momentum, and in the cataract environment the salting clasts

may attain necessary velocity-mass to break when they collide with boulders in the stream bed. Granitic pebble abundance appears to reflect proximity to source rather than areal abundance of source rock. Comparison between granitic talus and stream pebbles shows equidimensional shape controlled by source-rock characteristics; no obvious evolution in shape results from transport.—*from* Authors' summary

Plant, A. G. *See* Aumento, F. 04726

Plinston, David T. *See* Kemp, Patrick H. 04577

04993 **Poag, C. Wylie; Skinner, Hubert C.** Correction of the type species of *Globulina* d'Orbigny: Tulane Studies Geology, v. 6, no. 3, p. 127–128, illus., 1968.

For more than 40 years *Globulina gibba* d'Orbigny has been recognized as the type species of *Globulina* d'Orbigny, 1839. It was designated by Cushman, but according to the International Code of Zoological Nomenclature this selection is invalid. When d'Orbigny erected *Globulina* as a subgenus of *Guttulina*, a single species, *Globulina caribaea* was placed in the new taxon; therefore that species is the type by monotypy. Since the original specimens of *G. gibba* are lost and no type locality was designated, a petition to uphold it would create taxonomic difficulties. The traditional definition of *Globulina* will be preserved by the corrected type designation rather than altered as would be necessary were *G. gibba* retained. The original specimen of *G caribaea* is lost, but the type level and the description and illustration are known.—ESL

04703 **Pokryshkin, V. I.** Mestorozhdeniya kaolina v respublike Kuba: Razved. i Okhrana Nedr 1968, no. 4, p. 61–64, illus., table, 1968.

A geological survey of Cuban territory over the period of 1961–1965 with the participation of Soviet and Czechoslovakian geologists discovered four deposits of primary kaolins, including a large (1600 sq km, 15 million ton) deposit on the Isle of Pines. Data on the geology and mineralogical and chemical composition of the kaolins are tabulated. A schematic cross section of the largest deposit is given also.

Poldervaart, Arie. *See* Hess, H. H. 04639

Pratt, P. F. *See* Doner, H. E. 05130

04613 **Pratt, Wallace E.** Memorial to Arville Irving Levorsen (1894–1965): Geol. Soc. America Proc. 1966, p. 279–284, portrait, 1968.

04776 **Prescott, Glenn C., Jr.** Ground-water favorability areas and surficial geology of the lower Androscoggin River basin, Maine: U.S. Geol. Survey Hydrol. Inv. Atlas HA-285, scale 1:62,500, text, 1968.

Bedrock wells in the lower Androscoggin River basin average 158 feet in depth; yields range from 0–85 gpm and average 8 gpm. Quality of ground water is suitable for most purposes. Most aquifers are in Quaternary deposits and alluvium. The map provides a generalized interpretation of observed geologic and hydrologic data and a logical basis for directing further detailed exploration.—MCM

04865 **Presley, B. J.; Kaplan, I. R.** Changes in dissolved sulfate, calcium and carbonate from interstitial water on near-shore sediments: Geochim. et Cosmochim. Acta, v. 32, no. 10, p. 1037–1048, illus., tables, 1968.

Dissolved trace metal concentration, sulfate, carbonate, and calcium were determined in the interstitial water expressed from two marine cores off southern California. C-13/C-12 ratios were measured for both the total dissolved carbonate species, and for the solid carbonate in the sediment. The results indicate that the increase in dissolved carbonate with depth arises largely from metabolic activity, rather than solution of solid carbonates. Calculations indicate that surface interstitial water is undersaturated in calcium carbonate compared to surface sea water, but below 2 or 3 m, the interstitial water becomes supersaturated. It is suggested that solution of calcium carbonate under low pH, below the sediment-water interface, may result in transport of calcium from the sediment column into overlying sea water.—*from* Authors' abstract

04751 **Preuss, Luther E.; Toothacker, William S.; Bugenis, Claudius K.** Investigation and demonstration of single-crystal and powder diffraction by using zero-power beta-excited X-ray and ^{55}Fe isotopic sources, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 326–331, illus., 1968.

Powder-diffraction efficiency, with the use of a special diffractometer adapted to zero-power isotopic sources, is about 10^{-5} for the Mn$K\alpha$ X-rays on the NaCl 200 plane. This beam flux at three times natural background intensity was achieved by using photon spectrometry with proportional counters and multichannel analysis. The LiF diffraction pattern was roughly in agreement with prediction, the single-crystal diffraction intensity exceeded by 250-fold that of powder. This single-crystal intensity with 60-sec runs provided a peak resolution of 0.29° full width at half maximum. The isotopic source is stable, highly predictable in intensity, reliable, and compact. Requiring zero power, it has a potential for remote applications. Where its low output can be tolerated, it may hold promise for analysis.—*from* Authors' abstract

Price, P. Buford. *See* Fleischer, Robert L. 04709

05073 **Pulvertaft, T. C. R.** Precambrian stratigraphy of Western Greenland, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 4, Geology of Precambrian: Prague, Academia, p. 89–107, illus., 1968.

Western Greenland is built up of three main structural divisions, younger mobile belts having developed on either side of an older block. The older block consists mainly of granulite and amphibolite facies gneisses more than 2500 m.y. old. The younger mobile belt to the north, the Nagssugtôquidian belt, consists mainly of gneisses which give K-Ar dates between 1790 and 1650 m.y. At the southern margin the older block is overlain unconformably by a thick sequence of virtually unmetamorphosed sedimentary and volcanic rocks which increase in metamorphic grade southward. A late recrystallization accompanied by late-orogenic calc-alkaline magmatic activity has taken place throughout much of the Ketilidian mobile belt, with the result that K-Ar ages are generally younger than the Hudsonian peak, lying mostly between 1640 and 1590 m.y.—*from* Author's abstract

04571 **Pyke, D. R.** Fallon Township, District of Timiskaming: Ontario Dept. Mines Prelim. GeolpMap P. 496, scale 1 in. to 1/4 mi., text, 1968.

Intercalated metavolcanic flows and pyroclastics, oldest rocks in Fallon Township, are of basalt-andesite composition in the northern part and of dacite-rhyolite in the southern. Felsic volcanics are almost wholly confined to the southeast quadrant. Relatively flat-lying sediments of the Cobalt Group form a series of high hills in the west-central section. Diabase dikes cut all rocks and regional metamorphism is of greenschist grade. Dip of foliations in felsic volcanics suggests the presence of a synform with NW-SE axial traces across the southeast quadrant; however, two pillow-top determinations suggest the main structure is anticlinal. Faulting is generally N-S and NW; the Cobalt Group has been folded generally N-S. Pyrite is common in volcanic rocks and in veins.—MCM

04572 **Pyke, D. R.** Fasken Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 497, scale 1 in. to 1/4 mi., text, 1968.

Coarse-grained, foliated granodiorite underlying eastern Fasken Township, forms part of a large batholith extending north, south, and east. Felsic volcanic flows and fragmentals underlying most of the western portion are rhyolitic volcanics in the southwest corner and strongly foliated dacitic to intermediate volcanics in outcrops north of High Falls; the most eastern volcanic outcrops appear to be mostly mafic in composition. Diabase dikes cut all rocks. All foliations in the volcanics are subparallel to the granodiorite contact and dip steeply westerward. The Montreal River fault extends across the southwest quadrant, and a N-S striking fault appears to coincide with Whitefish River. Although disseminated pyrite in minor amounts was the only sulfide observed, volcanics close to the granodiorite contact could be favorable hosts for hydrothermal mineralization.—MCM

04794 **Quesada, Antonio; Dennen, William H.** Determinación espectroquímica de agua en minerales y rocas: Geos, no. 18, p. 41–47, illus., table, 1968; originally published in English, 1967.

The English version, with the title "Spectrochemical determination of water in minerals and rocks," was published in Appl. Spectroscopy, v. 21, no. 3, p. 155–156, 1967. For the authors' abstract of that paper, *see* Abstracts of North American Geology, October 1967.—VMJ

Raabe, R. G. *See* Fischer, R. P. 04773

04979 **Radwanski, S. A.** Field observations of some physical properties in alluvial soils of arid and semi-arid regions: Soil Sci., v. 106, no. 4, p. 314–316, 1968.

Alluvial soils may become sealed or water tight from alignment of mica flakes, from the growth of certain salts, from compaction by wind of silt and fine sand, and from water deposited or aquamorphic layers laid down during monsoon seasons.—JWH

Ramsey, T. L. *See* Huang, J. H. 05007

05119 **Ratté, James C.** Identification of ash-flow boundaries within densely welded tuff, Creede area, Colorado [abs.], *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 237, 1968.

05074 **Reid, Rolland R.; Greenwood, William R.** Multiple deformation and associated progressive polymetamorphism in the Beltian rocks north of the Idaho batholith, Idaho, U.S.A., *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 4, Geology of Precambrian: Prague, Academia, p. 75–87, illus., tables, 1968.

Beltian metasedimentary rocks of the St. Joe area have undergone several separate deformational events. Two major Precambrian events occurred successively with N 70° W and N 50° W trends, with different styles of deformation and with different directions of tectonic transport. Transcurrent movements and thrust faulting in the St. Joe fault zone were the predominant effects of the youngest Precambrian event. At least two younger fold events and two generations of orthogneiss, possibly Mesozoic, occur. The sedimentary rocks have been subjected to several sets of metamorphic conditions, with progression from zeolite facies on the north to amphibolite facies on the south. An early, major metamorphism was of Barrovian style with both synkinematic and static episodes. This was followed by a major metamorphism of East Pyrenees style, again with both synkinematic and static episodes.—*from* Authors' abstract

04724 **Reishus, Mark.** The Newcastle Formation in the Williston basin of North Dakota: North Dakota Geol. Survey Rept. Inv. 47, 26 p., illus., 1968.

Traced from the Black Hills into subsurface eastern and western North Dakota, this Lower Cretaceous sandstone is a coarse facies of conformable shales above and below it. In areas without the coarse facies, the shale section has been called "undifferentiated Mowry–Skull Creek". Correlation between the Newcastle Formation of east and west can be traced through an area near the southern State line. The Newcastle appears to be a near-shore blanket, thickening eastward along the Minnesota border, with up-dip overlap on successively older units of the Dakota Group on two small structural noses in the northeast, and a suggested delta complex in the southeast. Rapid thickening and thinning in the west was probably due to offshore currents; the Nesson anticline was a partial barrier, controlling current locations. Three sandstof masses extending from the southwest may be ancient deltas.—GDC

Reynolds, John. *See* Pepin, Robert. 04833

04758 **Rhodes, J. R.; Furuta, T.** Applications of a portable radioisotope X-ray fluorescence spectrometer to analysis of minerals and alloys, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 249–274, illus., tables, 1968.

A portable, battery-operated analyzer consists of a scintillation-counter probe and an electronic unit with a single-channel pulse-height analyzer and reversible scaler. Radioisotope X-ray sources are used for excitation, and balanced filters for resolution of neighboring characteristic X-rays. The instrument was designed to operate in laboratory, factory, or field conditions, and can measure equally well rock faces or powder, briquette, or liquid samples. Analyses are given for sulfur in coal, calcium and iron in cement mix, copper in ores, and vanadium, chromium, molybdenum, and tungsten in steel. Detection limits range from 0.03 percent for copper in ores to 0.2 percent for sulfur in coal. Both matrix absorption and enhancement effects were encountered but were eliminated by choice of source energy, use of nomographs, or semi-empirical correction factors.—*from* Authors' abstract

Rhodes, Rodney C. *See* Elston, Wolfgang E. 05123

05145 **Rich, C. I.** Hydroxy interlayers in expansible layer silicates [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 1, p. 15–30, tables, 1968.

Vermiculites and smectites in soils and sediments are often partially interlayered or 'chloritized'. Dioctahedral expansible layer silicates are most frequently interlayered, and hydroxy-Al appears to be the principal component of the nonexchangeable interlayer material. Most favorable soil conditions for interlayer formation appear to be: moderate pH, frequent wetting and drying cycles, and low organic matter content. In marine sediments, hydroxy-Mg interlayering may be significant. Soil-derived clays containing partially filled hydroxy-Al 'brucite' sheets may be filled out with hydroxy-Mg. Under reducing conditions, hydroxy-Fe interlayers may be important. Depending on the OH/Al ratio and Al content of hydroxy-Al interlayers, expansible layer silicates may either promote or retard formation of gibbsite. Interlayered expansible layer silicates also may be precursors to kaolinite.—*from* Author's abstract

Richards, M. L. *See* Francheteau, Jean. 05000

Richardson, Everett V. *See* Nordin, Carl F. 05164

04811 **Richardson, Stephen W.** Staurolite stability in a part of the system Fe-Al-Si-O-H: Jour. Petrology, v. 9, no. 3, p. 467–488, illus., 1968.

Experimental investigations were carried out to determine equilibria defining the pressure and temperature limits of staurolite occurrence in common rock compositions. For appropriate bulk composition, the data permit recognition of three regions of approximately equivalent temperature, but different pressure, that are distinguished by particular phase assemblages that may prove to be the equivalents of particular mineral facies.—MS

05008 **Rinehart, John S.** Geyser activity near Beowawe, Eureka County, Nevada: Jour. Geophys. Research, v. 73, no. 24, p. 7703–7706, illus., 1968.

The Beowawe, Nevada, geyser area was revisited in January 1968, and an attempt was made to establish seismic signatures and short time temperature histories of the water in the three now active geysers. One of the geysers has a distinctive seismic signature, but the other two exhibit only the background noise characteristic of bubbling springs. In one of the latter geysers, the water gushes up and recedes regularly between eruptions. The temperature of the water in the basins of the other two geysers fluctuates only a few degrees, but in a very regular manner from eruption to eruption.—Author's abstract

04799 **Risser, Hubert E.; Major, Robert L.** History of Illinois mineral industries: Illinois Geol. Survey Educ. Ser. 10, 30 p., illus., 1968.

This is a brief review of important historical events related to the growth and development of mineral industries in Illinois. In 1968, the State ranked ninth in the United States in value of minerals produced annually; it ranks first in production of fluorspar, second in stone, fourth in coal, sixth in sand and gravel, and is the

principal producer of tripoli. Illinois also produces large quantities of petroleum, silica sand, clay and clay products, portland cement, lime, and peat.—MCM

04986 **Roberts, S.; Koehler, F. E.** An X-ray spectrographic method of determining total sulfur in soil extracts: Soil Sci., v. 106, no. 3, p. 164–171, illus., tables, 1968.

An application of the X-ray fluorescence was developed for determining total S in soil extracts. The procedure permitted analysis of 40 soil extracts per day with half the time devoted to sample preparation and half the time used for X-ray fluorescence analysis.—JWH

05136 **Robinson, E.** *Chubbina*, a new Cretaceous alveolinid genus from Jamaica and Mexico: Palaeontology, v. 11, pt. 4, p. 526–534, illus., 1968.

Chubbina jamaicensis gen. et sp. nov. and *Chubbina macgillavryi* sp. nov. from the Cretaceous rocks of Jamaica and southern Mexico are described. *Borelis cardenasensis* Barker and Grimsdale is placed in the new genus. *Chubbina* appears to be a useful index for the Upper Cretaceous (upper Campanian to Maastrichtian) of the Greater Antilles and Central America.—Author's abstract

05132 **Rodgers, P. W.** The response of the horizontal pendulum seismometer to Rayleigh and Love waves, tilt, and free oscillations of the Earth: Seismol. Soc. America Bull., v. 58, no. 5, p. 1384–1406, illus., 1968.

The horizontal pendulum seismometer is sensitive not only to acceleration along its sensitive axis but also to tilt, variations in angle of inclination, and along-the-boom acceleration. An equation of motion is developed which includes these effects and an approximate solution is obtained which separates out the response due to each. A developed correction factor for Rayleigh waves is universal in the sense that it is independent of the particular seismometer parameters and applies to all pendulous horizontal seismographs. For Rayleigh waves it is a function only of ellipticity, phase velocity, and period. Correction factor curves for long-period retrograde Rayleigh waves are presented, the problem of obtaining horizontal ground motion is treated, response of the horizontal seismometer as a tilt meter is examined, and complete response to simultaneous spheroidal and torsional free oscillations of the Earth is developed.—*from* Author's abstract

04718 **Roliff, W. A.** Oil and gas exploration—Anticosti Island, Quebec [with French abs.]: Geol. Assoc. Canada Proc., v. 19, p. 31–36, illus., 1968.

Exploratory activities carried out on the western part of Anticosti Island, Quebec include aeromagnetic, seismic, and geological surveys, photogeology studies, and the drilling of six holes. The rocks are 3,000–11,000 feet thick, consist of limestone, shaly limestone, and calcareous shale, with some dolomite and a few sandstone beds, and range in age from Early Ordovician to Silurian. In general they dip southerly at low angles. Some oil staining or traces of oil and gas were present at several depths in the holes drilled, but porosity and permeability were low and commercial production was not obtained. The geological data obtained indicated the presence of faults of magnitudes hitherto unsuspected and the existence of several important unconformities.—Author's abstract

05072 **Rõõmusoks, A.** On the relation between the Ordovician brachiopod faunas of northern Estonia, Scandinavia, Bohemia, Britain and North America, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 9, Stratigraphy of central European lower Paleozoic: Prague, Academia, p. 21–29, 1968.

In the Viru Series (Middle Ordovician) of northern Estonia local and immigrant brachiopod genera are represented in equal numbers (24 genera each). More than half of the immigrants belong to genera of North American origin. In the Harju Series (Upper Ordovician of northern Estonia, 25 out of 29 recorded genera were immigrant and 15 of these genera are of North American origin.—KAF

04650 **Rose, Harry J., Jr.; Cuttitta, Frank.** X-ray fluorescence spectroscopy in the analysis of ores, minerals, and waters, *in* Advances in X-ray analysis, V. 11

Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 23–30, illus., tables,, 1968.

The technique has been a powerful analytical tool in the survey of mineral deposits, as a control to monitor ore flotation processes, for semimicroanalysis of mineral separates and of rare new mineral species, and for determination of trace elements in waters. Many preparation techniques have been developed for analysis of complex mineral systems, some combining with other analytical techniques to provide a complete analysis. These, coupled with improvements in instrumentation, have extended analytical ranges to the microgram level and included elements that were previously not detectable. Significant advances in sample preparation and methods development have been made in analysis of milligram quantities of complex geologic materials. Fusion and solution of specimens appear to be preferred methods of sample preparation. For samples that vary markedly in composition, the slope-ratio technique offers a new approach.—*from* Authors' abstract

04730 **Rose, John L.** Injection of treated waste water into aquifers: Water and Wastes Eng., v. 5, no. 10, p. 40–43, illus., tables, 1968.

Bedrock under Long Island slopes from near surface at the north shore to a depth of 1,500 feet at the south shore, and is overlain by a wedge-shaped mass of unconsolidated sediments, forming the ground-water reservoir. In Nassau County, glacial deposits initially served as the principal source of water, and waste water was returned to the same strata through cesspools and tile fields, but increased pumpage and construction of public sewer systems conveying waste water to the sea, are threatening to lower ground-water levels and cause salt-water intrusion. If injection of tertiary-treated waste waters to restore balance proves feasible, initial injection would occur along the southern perimeter of the county to form a barrier against salt-water intrusion. Ultimately, reclamation plants would be constructed for direct injection.—ESL

05112 **Rosenkrantz, Alfred.** Interglaciale og postglaciale skalaflejringer fra Umanak distrikt [abs.]: Dansk Geol. Foren. Medd., v. 18, no. 1, p. 146–147, 1968.

Ross, S. H. *See* Jones, R. W. 04853

04875 **Rossmann, Ronald; Callender, Edward.** Manganese nodules in Lake Michigan: Science, v. 162, no. 3858, p. 1123–1124, illus., table, 1968.

Manganese nodules containing up to 22 percent manganese oxide were found in Green Bay and the western and northern parts of Lake Michigan. The chemical composition of these nodules resembles that of shallow-water lacustrine and marine nodules. The manganesee content of the interstitial water is in some places enriched as much as 4000 times over that of lake water.—Authors' abstract

04809 **Rothman, Robert L.** A note on the New England earthquake of November 18, 1755: Seismol. Soc. America Bull., v. 58, no. 5, p. 1501–1502, 1968.

Reports of a seismic sea wave associated with the New England earthquake of November 18, 1755 were investigated. Evidence indicates that such reports were erroneous and that the tsunami in question occurred on November 1, 1755 and was associated with the Lisbon earthquake of that date.—Author's abstract

04600 **Rouse, John T.; Behre, Charles H., Jr.** Memorial to Walter Herman Bucher (1888–1965): Geol. Soc. America Proc. 1966, p. 195–203, portrait, 1968.

04733 **Rowland, Richards A.** History of the Clay Minerals Society: Clays and Clay Minerals, v. 16, no. 4, p. 319–321, 1968.

The first National Clay Conference, held in California in 1952 was an outgrowth of interest developed by the Symposium on Problems of Clay and Laterite Genesis, held in 1951. In the fall of 1952 the Natl. Academy of Sciences-Natl. Research Council appointed the first Clay Minerals Committee in the Division of Earth Sciences. Every year a committee was appointed and a conference held, until 1962 when an independent organization, the Clay Minerals Society, was incorporated.

At the first meeting as an independent society in 1964, there were more than 500 members. Presidents of the society and past Clay Conferences are listed, and publication of the proceedings discussed. An arrangement has been worked out with Pergamon Press to publish a bi-monthly periodical, Clays and Clay Minerals, beginning in 1968 with papers from the Denver Conference.—ESL

Rubin, Meyer. *See* Frye, John C. 04839

Rubinstein, M. *See* Gabunia, L. 05062

04574 **Rudman, Reuben.** Single-crystal alignment with a polaroid adapter for the Weissenberg goniometer: Jour. Appl. Crystallography, v. 1, pt. 2, p. 126–128, illus., 1968.

An adapter which supports a polaroid flat-plate film holder has been designed for a standard Weissenberg goniometer. A number of applications, including a method for rapidly aligning single crystals, are described.—Author's abstract

04609 **Ruhlmann, E. Robert.** Memorial to Bertrand Leroy Johnson (1882–1962): Geol. Soc. America Proc. 1966, p. 257–259, portrait, 1968.

04684 **Runcorn, S. K.** Napravleniye paleovetrov i paleomagnitnyye shiroty, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 244–255, illus., table, 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

04695 **Runcorn, S. K.** Svyaz' paleomagnetizma s paleoklimatologii, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 95–103, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

Runyan, Damon R. *See* Everitt, Martin C. 04847

Saito, Tsunemasa. *See* Blow, W. H. 05012

04638 **Sandefur, Bennett T.** Memorial to Justin Zinn (1903–1966): Geol. Soc. America Proc. 1966, p. 407–409, portrait, 1968.

05077 **Sando, William J.** A new member of the Madison Limestone (Mississippian) in Wyoming: Geol. Soc. America Bull., v. 79, no. 12, p. 1855–1857, illus., 1968.

The new name Bull Ridge Member of the Madison Limestone is proposed for a widespread stratigraphic unit of early Meramec age in central Wyoming. This name replaces the name Sacajawea as used by some authors in the Wind River and Owl Creek Mountains.—Author's abstract

04719 **Sanford, John T.; Mosher, Robert E.; Friend, Joseph E.** A quantitative study of Silurian rocks from the Michigan basin: Geol. Assoc. Canada Proc., v. 19, p. 37–44, illus., table, 1968.

Two subsurface sections were determined and correlated by chemical analyses of hydrochloric acid-soluble constituents and semiquantitative insoluble residues of 475 samples of Niagaran and Alexandrian carbonate rocks. Data obtained from small samples (220–500 mg) compared favorably with those from larger samples thus indicating the practicability of using analytical methods in subsurface work; previously, sample size has been a limiting factor. Analytical results from the Michigan rocks showed that clastic and nonclastic silica could not be distinguished, but with visual estimates of the residues, proportions of clastics and nonclastics could be determined. A correlation between Mg and Fe as well as a relationship

between proportions of Ca, Mg, and total solubles was noted. The occurrence of some fossils, as exemplified by agglutinated foraminifers, appeared to be related to lithology.—BSH

05154 **Sanger, David.** Prepared core and blade traditions in the Pacific Northwest: Arctic Anthropology, v. 5, no. 1, p. 92–120, illus., tables, 1968.

Artifact collections of prepared cores and blades from about 20 sites in southern British Columbia, Washington, and northern Oregon are discussed, pertinent literature of the past 20 years is reviewed, and new material is described. Radiocarbon dates, some new, on associated materials range from about 8000 B.C. to A.D. 500. Two distinct, historically unrelated traditions are indicated. The macroblade tradition is represented in early postglacial sites and probably extends far beyond this region. The later microblade tradition has played an important role in development of the historic Plateau culture. The Drynoch Slide site, British Columbia, has yielded the thus far oldest microblade from beneath the Mazama volcanic ash (4500 B.C.); associated charcoal is dated to 5500 B.C.—VMJ

04714 **Sangster, D. F.** Relative sulphur isotope abundances of ancient seas and strata-bound sulphide deposits [with French abs.]: Geol. Assoc. Canada Proc., v. 19, p. 79–91, illus., tables, 1968.

Average sulfur isotopic compositions of 66 sulfide bodies in Precambrian to Tertiary rocks are compared with contemporaneous sea-water sulfate. Ore-bodies are classified as either 'sedimentary' or 'volcanic'; a parallel variation existed between isotopic compositions of such deposits and ancient seas throughout geologic time. Average fractionation factor for sedimentary types is 11.7 per mil with respect to parental sea-water sulfate; volcanic types is 17.5 per mil. In trend direction, range and magnitude, agreement exists between average isotopic fractionation in deposits and that produced by bacteria. Data indicate that sulfur in sedimentary deposits and a portion of volcanic types was derived from contemporaneous sea-water sulfate and reduced to sulfide by bacteria. Slightly greater depletion of S-34 in volcanic deposits probably resulted from incorporation of isotopically lighter volcanic sulfur at time of formation.—*from* Author's abstract

04828 **Sawyers, Kenneth N.** Theoretical changes in seismic travel time with changes in stress at depth: Seismol. Soc. America Bull., v. 58, no. 5, p. 1667–1680, tables, 1968.

Use is made of second-order elasticity theory to derive an estimate of the change in traveltime with stress for compressional waves which propagate along the principal stress directions in a homogeneous layer of material. A particular stress system is chosen which can be expected to produce a strike-slip fault. Laboratory data for Barre, Vt., granite, interpolated for a depth of approximately 1 km, are used to obtain a numerical result. The change in traveltime is found to be 0.075 milliseconds per km per bar. Since timing precision of better than ± 1 millisecond can be achieved for refraction paths up to some 40 km in length, it is concluded that stress changes of several bars are within the range of detectability in carefully executed field experiments.—Author's abstract

04621 **Schairer, J. F.** Memorial to George Washington Morey (1888–1965): Geol. Soc. America Proc. 1966, p. 325–327, portrait, 1968.

Scheidegger, A. E. *See* Chung, C. L. 05102

04568 **Scheidegger, Adrian E.** Horton's laws of stream lengths and drainage areas: Water Resources Research, v. 4, no. 5, p. 1015–1021, illus., tables, 1968.

Most customary explanations for Horton's metric laws of stream lengths and drainage areas are based on the idea that in river nets one can speak of cycles or generations of rivers. However, this customary explanation presupposes certain topological features in river basins that do not seem to occur in nature. Hence, the theory in which river nets are assumed to be simply random connections of channels is further applied. Upon this basis, a rational explanation of the two metric

laws is obtained which is free from any specific structural assumption regarding a river net.—Author's abstract

05001 **Schimke, Gerald R.; Bufe, Charles G.** Reply [to comments by Jean Francheteau and others on "Geophysical description of a Pacific Ocean seamount" (1968)]: Jour. Geophys. Research, v. 73, no. 24, p. 7716–7717, illus., 1968.

Francheteau and others (ibid, p. 7713–7715) have a valid criticism of Schimke and Bufe's paper (ibid, v. 73, no. 2, p. 559–569, 1968): inasmuch as there is an error in Table 1 which leads the critics to the erroneous conclusion that the top of the Chautauqua seamount is weakly magnetized in the same direction as the main body; the evidence, though weak, is to the contrary. In view of recent results indicating a magnetization similar to that of Chautauqua for other seamounts southwest of the Hawaiian ridge, some of which have been dated as Cretaceous, it would appear that the Chautauqua seamount may have originated on the flank of a remote, presently inactive mid-ocean rise during Cretaceous time, as suggested by Schimke and Bufe in a later work (Nature, v. 219, no. 5161, p. 1351–1352, 1968).—DBV

05155 **Schlee, John.** Sand and gravel on the continental shelf off the northeastern United States: U.S. Geol. Survey Circ. 602, 9 p., illus., 1968.

Most of the continental shelf off New England, Long Island, and New Jersey is mantled by sand associated with lesser amounts of gravel in a quantity probably sufficient to constitute an economic asset. The mantle extends eastward onto Georges Bank and the Scotian Shelf. The sand is quartzose and fine to coarse grained. Gravel is associated with drowned river-terrace deposits of the ancestral Hudson River off New Jersey and with glaciofluvial deposits off Rhode Island and Massachusetts. A few shallow drill holes on the shelf indicate that the sand is as much as several meters thick. Shallow continuous seismic profiles show that uppermost layers on the inner shelf are fairly continuous over much of the area, though the layers vary in thickness.—Author's abstract

04888 **Schmalhausen, I. I.** The origin of terrestrial vertebrates: New York, Academic Press, 314 p., illus., 1968; originally published in Russian, 1964.

Evolution of the lower vertebrates is traced from the earliest agnathans preserved (Late Ordovician–Silurian) through the origin of Amphibia from primitive Crossopterygii (not from the specialized Dipnoi), in the Upper Devonian, to the beginnings of cotylosaur reptiles (Early Permian) from the seymourian amphibians. Reptiles and higher vertebrates are not treated; emphasis is on evolution of the groups of Amphibia and their transition from aqueous to terrestrial–aerial existence. Principal attention is given to detailed skeletal anatomy, with supplementary treatment of associated soft parts, sense organs, and embryology. Paleoecology and phylogenetic relationships are interpreted.—VMJ

04857 **Schnaible, R. A.** Engineering geology of Hells Canyon Hydroelectric Project, Idaho, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 328–339, illus., 1968.

Construction of the Hells Canyon Hydroelectric Project is nearing completion. The development is located on the Snake River about 115 miles northwest of Boise, Idaho. It consists of a 330-ft high concrete gravity dam, a powerhouse with a rated capacity of 391,500 kw, and a spillway capable of passing 300,000 cu ft per sec. The engineering geology was conducted in stages, starting with reconnaissance and feasibility studies and completing in the design investigations. This was followed by geologic inspection of the foundations during the construction. Due to the geologic conditions of the area, and the precipitous canyon, the geologic studies were important in siting the project, formulating certain design concepts and evaluating specific design and construction considerations.—Author's abstract

Schreiner, Robert N. *See* Galbraith, Frank W. 04584

05093 **Schroeder, Richard J.; Hayes, John B.** Dickite and kaolinite in Pennsylvanian limestones of southeastern Kansas [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 1, p. 41–49, illus., 1968.

Dickite and kaolinite occur in cavities in phylloid algal limestones, in interstices of biocalcarenites and sandstones, and along joints, fractures, and stylolites in Pennsylvanian rocks. The stratigraphic interval, about 1,100 feet, extends from the Fort Scott to the Lecompton Limestones. Best crystallized specimens are in porous algal limestones as pockets of white powder. Dickite is confined to an oval area 125 mi long, extending 60 mi east from igneous intrusions in Woodson and Wilson Counties, and is associated with algal mounds. Kaolinite occurs in less porous rocks within this area and beyond. Heated ground waters moving up-dip and along strike, following the conduit-like algal mounds, deposited the dickite. Where water movement was restricted or it had traveled far, and temperature fell below the limit for dickite, kaolinite was deposited.—ESL

04844 **Schroeder, W. L.; Schuster, R. L.** Liquefaction phenomena in saturated sands, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 1–22, illus., table, 1968.

Laboratory experiments, designed to investigate the stress effects of an earthquake on granular soil deposits, have resulted in the following general conclusions: "(1) pore water-pressure increases are greater for lower initial principal effective stress ratios, (2) pore water-pressure increases become smaller with increasing initial effective confining pressure, (3) greater disturbances produce greater pore-pressure increases, and (4) increasing the ratio of initial pore water-pressure to initial intergranualar pressure produces a more liquifaction-susceptible condition." The variables investigated were those pertaining to foundation design.—HRC

Schuster, R. L. *See* Schroeder, W. L. 04844

04848 **Schwarz, Sigmund D.** Geophysical site exploration, Third Lake Washington Floating Bridge, *in* Engineering geology and soils engineering symposium, 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 147–156, illus., 1968.

Vertical velocity measurements in a drill hole and seismic reflection and refraction surveys were made across Lake Washington to determine the configuration of the valley and the nature and amount of sedimentary fill. The major valley parallels the shoreline along the west edge of the lake and narrows to the north; it varies from 2,500 to 4,000 feet wide, has a valley bottom elevation of −200 feet referred to the City of Seattle datum, and a maximum sediment fill of 250 feet. A secondary valley, parallel to the west side of Mercer Island, is about 1,500 feet wide, has a valley bottom elevation of −160 feet, and a lacustrine sediment fill of about 80 feet. The original valley was eroded in intraglacial and postglacial sediments including lacustrine deposits, till, and outwash material; some faults are associated with underwater slumping.—HRC

Sclater, J. G. *See* Francheteau, Jean. 05000

04628 **Scofield, Lloyd M.** Memorial to Hugh Marine Roberts (1885–1965): Geol. Soc. America Proc. 1966, p. 357–361, portrait, 1968.

Scott, A. D. *See* Marques, J. M. 04734

04728 **Secor, D. T.; Wagener, H. D.** Stratigraphy, structure, and petrology of the Piedmont in central South Carolina—Carolina Geol. Soc. Field Trip, Oct. 18–20, 1968: South Carolina Div. Geology Geol. Notes, v. 12, no. 4, p. 67–84, table, geol. map, 1968.

Slate Belt rocks near Columbia were deposited as a sedimentary sequence over 15,000 feet thick in three major units, here named the Richtex, Persimmon Fork, and Wildhorse Branch Formations, and were intruded, folded, faulted, and metamorphosed to greenschist and amphibolite facies. The Charlotte Belt, trending northeast in the north-central part of the area, contains some of the same stratigraphic units. Metamorphism varies from greenschist to amphibolite facies, but many primary sedimentary or volcanic features can still be recognized. Major fold axes trend northeast in the Slate Belt, and folds are overturned in the opposite direction from that usually found. Large faults trend N 75° E to E–W, are vertical or steeply dipping, and appear to have a large strike-slip component. The northeast

end of a belt of high grade metamorphic rocks appears in the Lake Murray Spillway.—ESL

04582 **Seed, H. Bolton.** Landslides during earthquakes due to soil liquefaction: Am. Soc. Civil Engineers Proc., v. 94, paper 6110, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1055–1122, illus., table, 1968.

The first objective is to examine the frequency and conditions of occurrence of landslides during earthquakes due to soil liquefaction. It is necessary, in order to evaluate the severity of the problem, to compile a list of known slides in which liquefaction has played a part. A review of the list shows that slides have invariably been initiated by liquefaction of saturated sandy soils in a loose to medium dense condition as a result of earthquakes varying in magnitude from 5.5 to 8.5 points in Richter scale and at epicentral distances varying from several miles to hundreds of miles. The second objective is to illustrate the importance of minor geologic and technical details in determining the occurrence and nature of landslides during earthquakes due to soil liquefactions.—*from* Author's abstract

04765 **Segerstrom, Kenneth.** Geochemical prospecting for copper, lead, and zinc in the west-central part of the Negaunee quadrangle, Marquette County, Michigan: U.S. Geol. Survey Misc. Geol. Inv. Map I-559, 1 sheet, text, 1968.

The map sheet includes geologic maps (scale about 1 in. to 400 feet) of five major areas of anomalous concentrations of copper, lead, and zinc in west-central Negaunee quadrangle, and three maps (scale about 1 in. to 100 feet) showing concentrations in Area 1A. Early Precambrian greenstone intruded by quartz porphyry and diabase sills and dikes generally underlies three northwest-trending anticlinal ridges in the five areas; crests and south flanks of the ridges are thinly and incompletely covered by ground moraine and colluvial deposits. Structural and topographic trends strike west to northwest. Analytical results in Area 1 show a close spatial relationship between most of copper and zinc anomalies and two north-northwest-striking shear zones; anomalies in other zones are delineated. Histograms show soil and stream-sediment samples having 25 ppm and 100+ ppm Cu, PB, or Zn.—MCM

04791 **Seibel, Clifford W.** Helium—Child of the Sun: Lawrence, Kans., Univ. Press of Kansas, 138 p., illus., 1968.

For 27 years after the name helium had been suggested by Sir Norman Lockyer, in 1868, for the type of atom believed to be the source of a newly observed yellow line in the Sun's spectrum, the very existence of the element was little more than hypothetical. In 1903 a sample of natural gas from a new well at Dexter, Kans., analyzed at the University of Kansas, contained an unusually high proportion of nitrogen; two years later a complete analysis gave the spectrum of helium. A paper published by H. P. Cady in 1907 indicated a source of helium capable of exploitation on a large scale, but it was not until 1917 that attention was paid to advantages of helium for dirigibles and balloons. Since that time consumption has increased to a billion cu feet per yr. Analysis of thousands of gas samples in the United States shows about 90 percent of the helium is concentrated in a small area within 250 miles of Amarillo, Tex.—MCM

04700 **Semenov, E. I.; Kazakova, M. E.; Bukin, V. J.** Ilimaussite, a new rare earth-niobium-barium silicate from Ilímaussaq, South Greenland (Contribution to the Mineralogy of Ilímaussaq no. 10) [with Russian abs.]: Medd. Grönland, v. 181, no. 7, p. 1–7, tables, 1968.

A new mineral found in a hydrothermal vein in nepheline-sodalite syenite (naujaite) of the Ilímaussaq alkaline massif is described. Named ilimaussite after the locality where it was found, it forms brownish-yellow lamellae and is associated with ussingite, chkalovite, and epistolite. The specific gravity is 3.6. The mineral is optically uniaxial positive and belongs in the hexagonal system. Chemical composition is $SiO_2 = 31.28$, $TiO_2 = 1.64$, $Nb_2O_5 = 13.20$, $TR_2O_3 = 10.60$, $Fe_2O_3 = 3.18$, $BaO = 23.62$, $Na_2O = 7.00$, $K_2O = 3.80$, loss by ignition = 6.43.—*from* Authors' abstract

04701 **Semenov, E. I.; Sörensen, H.; Katajeva, Z. T.** On the mineralogy of pyrochlore from the Ilímaussaq alkaline intrusion, South Greenland (Contribution to the Mineralogy of Ilímaussaq no. 11) [with Russian abs.]: Medd. Grönland, v. 181, no. 7, p. 9–25, illus., tables, 1968.

Niobium-bearing minerals such as pyrochlore, igdloite (lueshite) and epistolite are of widespread occurrence in the intrusion. Furthermore, rock-forming minerals such as eudialyte and rinkite contain one percent or more of Nb_2O_5. Pyrochlore occurs mainly in rocks of supposed hydrothermal origin and is associated with analcime, natrolite, polylithionite, sphalerite, and a number of other minerals. Four types of pyrochlore are described and compositions given: brown pyrochlore associated with analcime in aggregates, gray pyrochlore forming irregular areas, white earthy pyrochlore which probably forms pseudomorphs after epistolite, and yellow siliceous pyrochlore associated with analcime and neptunite. Since it is not known whether the silica content is due to mechanical admixture or to isomorphic substitution, the Ilímassaq pyrochlore should be termed siliceous pyrochlore.—*from* Authors' abs ract

04783 **Shapiro, S. M.; Cummins, H. Z.** Critical opalescence in quartz: Phys. Rev. Letters, v. 21, no. 23, p. 1578–1582, illus., 1968.

The intense scattering of light by quartz in the vicinity of the α–β transition, first observed by Iakovlev and co-workers in 1955, has been studied by Raman and Brillouin spectroscopy and by visual observation. Our results indicate that the observed "opalescence" does *not* originate from critical fluctuations of the order parameter but is generated by essentially static domain walls separating microdomains of opposite electrical twins.—Authors' abstract

Sharp, Dennis A. *See* Beards, Ronald J. 05161

Shaukat Ali, M. *See* Kenney, T. Cameron. 04583

05138 **Shead, A. C.** Some natural landmarks of western Oklahoma: Oklahoma Acad. Sci. Proc. 1966, v. 47, p. 173–195, illus., 1968.

The Caddo County buttes are described physiographically and topographically, each identified by number and geographic location. Some of the larger ones having popular names, generally alluding to their profile, are dolomite and dolomitic sandstone erosional remants; many are illustrated.—HRC

05139 **Shead, A. C.** Spherulites in the phosphatic concretions of the Woodford Chert, Arbuckle Mountains, Oklahoma: Oklahoma Acad. Sci. Proc. 1966, v. 47, p. 171–172, illus., 1968.

Spherulites of dahllite, a member of the apatite family, have been identified in nodules which had been previously reported by Shead (1964). The mineral probably makes up a large part of the nodules but is, for the most part, obscured by opaque matter such as organic debris of one kind or another. The material is from nodules widely distributed in the Woodford Chert near Ada in Pontotoc County; the extent of the characterization of the spherulitic structures is problematical. Photomicrographs are included.—HRC

Sheridan, M. J. *See* Fischer, R. P. 04773

04845 **Sherif, M. A.; Wu, M. J.; Awad, I. S.** The effect of overconsolidation on the magnitude of lateral stresses in soils, *in* Engineering geology and soils engineering symposium 6th Ann., Boise, Idaho, 1968, Proc.: Boise, Idaho Dept. Highways, p. 45–63, illus., table, 1968.

In this paper, the authors advance an hypothesis indicating why the lateral stresses in soil media increase as a result of overconsolidation. They also discuss some of the basic features of the Stress Meter, an equipment designed and constructed at the University of Washington for the determination of the coefficients of earth pressures for soils under various axial stress levels. A working equation relating the coefficients of earth pressures to the overconsolidation ratio and the liquid limits

of the soils is proposed. Also, the dependency of the coefficient of earth pressures on the depth of the soil below the original ground surface is indicated.—Authors' abstract

05108 **Sherman, G. Donald; Ikawa, Haruyoshi.** Soil sequences in the Hawaiian Islands: Pacific Sci., v. 22, no. 4, p. 458–464, illus., tables, 1968.

Sequences related to rainfall, and those due to age are considered. Soils rich in montmorillonite develop in areas of low rainfall, kaolin where rainfall is moderate, and free oxides where the amount of rainfall favors complete leaching. Greater desilication in geologically older profiles is shown, with examples of the transition of one type of soil group to another of greater stability. A two-phase study of progressive rock weathering as it is related to the origin of parent materials is being made on a melilite nepheline basalt flow on Kauai. The first phase is to determine why products of rock weathering can range from kaolin to ferruginous bauxite on a single flow, with rainfall the chief variable. The second phase is a study of the effect of the nature of the first product of weathering on subsequent soil formation.—ESL

04663 **Sheynmann, Yu. M.** Tectonics of the upper parts of the mantle under geosynclines and island arcs, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS–NRC Pub. 1687), p. 466–472, illus., 1968.

Narrow zones of deep-focus earthquakes bear an important relation to mechanisms that create geosynclines and orogenic regions. Recent geosynclines—the areas of island arcs—are mainly, but not exclusively, confined to the rims of the oceans, particularly the Pacific. Zones of deep-seated earthquakes are also zones of magma melting. A main feature of these zones is the upwelling along them of a particularly strong current of energy. These zones should be considered as the most important structures in the depths of the earth; the name *tectonofer* is proposed for them.—Author's abstract

05043 **Shive, Peter N.** Destruction of thermoremanence in nickel by deformation: Nature, v. 220, no. 5174, p. 1314–1315, illus., 1968.

Experiments on single crystals of nickel show that the original TRM is destroyed by very small strains. Therefore, the chief effect on rocks of a moderate amount of plastic deformation may be simply destruction of the original TRM, even if the rocks are deformed in the Earth's field. Such a process would be a contributing factor to the disappearance of the strong linear magnetic anomalies in the sea floor near the flanks of the deep trenches. The question of whether the mininum amount of plastic deformation needed to destroy the TRM of magnetite can occur under the stress conditions existing in the crust is being investigated.—DBV

04622 **Shrock, Robert R.; Hooker, Marjorie.** Memorial to Fredrick Kuhne Morris (1885–1962): Geol. Soc. America Proc. 1966, p. 329–335, portrait, 1968.

04633 **Shrock, Robert R.** Memorial to Hervey Woodburn Shimer (1872–1965): Geol. Soc. Ameerica Proc. 1966, p. 379–385, portrait, 1968.

05125 **Siems, Peter L.** Volcanic geology of the Rosita Hills and Silver Cliff district, Custer County, Colorado, *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 89–124, illus., table, 1968.

Volcanism within the Rosita Hills–Silver Cliff district is controlled by deep-seated, northwest-trending crustal fractures associated with Laramide uplift of the Wet Mountains. The Rosita Hills–Silver Cliff igneous rock suite is at the alkalic end of the alkali-calcic class and is petrologically related to the suite of igneous rocks at Spanish Peaks. It represents a liquid line of descent by magmatic differentiation from a trachyandesite parent magma which probably resulted from total or partial fusion of crustal rocks. K–Ar ages indicate that volcanism started in the late Eocene, continued for about 5 m.y., and closed in the early Oligocene.—*from* Author's abstract

05101 **Siever, Raymond.** Establishment of equilibrium between clays and sea water: Earth and Planetary Sci. Letters, v. 5, no. 2, p. 106–110, illus., 1968.

Kaolinite, montmorillonite, and illite were reacted with silica-spiked natural and artificial sea water to demonstrate the effect of prolonged grinding of the clay, pH, and dissolved silica concentration. Grinding greatly increases the reactivity so that the extent of reaction is appreciable after one week. Clays dissolve at low pH and low dissolved silica concentrations but will combine with alkalies and silica at higher pH and higher dissolved silica concentrations, presumably forming a more siliceous, more alkaline clay. Equilibrium pH and silica concentration can be bracketed from initial reactions in this way.—Author's abstract

04891 **Silberling, N. J.; Tozer, E. T.** Biostratigraphic classification of the marine Triassic in North America: Geol. Soc. America Spec. Paper 110, 63 p., illus., 1968.

The authors have pieced together various local sections where parts of the Triassic ammonoidal fauna are preserved, in overlapping fashion into a unified sequential framework of biostratigraphic units presented in an annotated zonal chart. At least 35 zonal units of demonstrably different age are now recognized; these units are apportioned among the Griesbachian, Dienerian, Smithian, and Spathian Stages of the Lower Triassic; the Anisian and Ladinian Stages of the Middle Triassic; and the Karnian, Norian, and Rhaetian Stages of the Upper Triassic. This zonation based on North American ammonoid faunas for the first time provides an objective and reasonably detailed standard of reference for expressing the age and correlation of the marine Triassic rocks of Canada and the United States.—Authors' abstract

Simmons, Gene. *See* Horai, Ki-iti. 05003

Simon, Ivan. *See* McConnell, R. K., Jr. 05031

04731 **Simpson, George G.** Kosmische Aspekte der organischen Evolution [translation of English preprint]: Naturw. Rundschau, v. 21, no. 10, p. 425–434, 1968.

Immutable inherent general characteristics of environment and the possible existence of creatures similar to man elsewhere in the universe are discussed with reference to the cosmic aspects of organic evolution. Reference is made in particular to cause and effect relationships, convergence, and irreversible trends in evolutionary processes, as well as to divergence relative to certain environmental relationships.—MS

04769 **Simpson, Howard E.** Surficial geologic map of the Durham quadrangle, Middlesex and New Haven Counties, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-756, scale 1:24,000, 1968.

04592 **Singh, Krishan P.** Some factors affecting baseflow: Water Resources Research, v. 4, no. 5, p. 985–999, illus., 1968.

For a shallow aquifer and a fully penetrating stream, the ideal baseflow curve does not plot as a straight line on semilog paper, and its recession rate continuously decreases with time. For a deep aquifer and a shallow-entrenched stream, ideal baseflow decays exponentially, and its recession rate decreases with increasing stream entrenchment. In loss from evapotranspirationn, baseflow curves steepen progressively with time and the stream may become influent. In case of gain from confined aquifers, baseflow curves become flatter. Recharge results in shifting of curves upward in magnitude or laterally in time. The baseflow peak occurs at about $0.75T$ from the beginning of recharge, where T denotes effective duration of recharge. The lag between total flow peak and baseflow peak depends on rainfall, soil, and basin factors. The variability of these facctors precludes the notion of a constant lag.—*from* Author's abstract

04835 **Siple, George E.** Water resources investigations in South Carolina: South Carolina Div. Geology Geol. Notes, v. 12, no. 2, p. 19–24, 1968.

Summaries of all 18 projects recently carried out in South Carolina by the three branches of the Water Resources Division of the U.S. Geological Survey are given. Eight of these involve ground water.—ESL

Skinner, Hubert C. *See* Poag, C. Wylie. 04993

04994 **Sliter, William V.** Shell material variation in the agglutinated foraminifer *Trochammina pacifica* Cushman: Tulane Studies Geology, v. 6, no. 2, p. 80–84, illus., 1968.

Test construction, reproduction, and rate of growth in specimens of *Trochammina pacifica* cultured without mineral grains are analogous to those of specimens supplied with sediment. Newly formed test chambers consist of fragile, organic membranes. Control specimens show selectivity for grain size but not for mineral composition. The median grain size of disaggregated control specimens agreed closely with the median grain size of the supplied sediment. The grain size in a test, however, increases gradually as individuals become larger during ontogenetic development. These findings are applicable to taxonomic analyses and to the paleoecological interpretation of fluctuating, shallow-water, marine environments and their depositional history.—Author's abstract

04567 **Smart, J. S.** Statistical properties of stream lengths: Water Resources Research, v. 4, no. 5, p. 1001–1014, illus., tables, 1968.

Two basic assumptions are employed: All topologically distinct networks with a given number of sources are equally likely, and lengths of interior links in a network are independent random variables drawn from the same population. Mathematical development leads to an approximate expression for mean length that contains no adjustable parameters and depends only on stream numbers and mean link length. This agrees better with data on actual stream systems than Horton's law of stream lengths. This procedure accounts for about 65 percent of the variance in mean stream length data for third- and fourth-order basins. If exact values of link numbers are introduced, unexplained variance is reduced to 15 percent. For a complete statistical description of stream lengths, the distribution of interior link lengths must be known. Computer simulation studies suggest that this distribution is negative exponential.—*from* Author's abstract

05142 **Smith, Harold M.** The effect of time and depth of burial on the naphtha and gas–oil content of crude oil: Oklahoma Acad. Sci. Proc. 1966, v. 47, p. 195–205, illus., 1968.

The U.S. Bureau of Mines has placed over 7,000 crude oil analyses on IBM cards. The data include naphtha content and the gas–oil content by geologic periods. Three tentative general conclusions stand out: (1) Naphthas from Tertiary oils contain the highest percentage of aromatics except for Permian oils. (2) Permian oils are unique in being the only oils of a period older than Tertiary that have a high content of aromatics in naphthas. (3) The normal expected aromatic content of a naphtha is 5 to 10 percent, with the two exceptions noted. Larger sampling is recommended before final conclusions can be made, and the sampling should cover all geologic periods.—HRC

Smith, J. V. *See* Bennett, J. M. 04789

Smith, James G. *See* MacKevett, E. M., Jr. 05156

04864 **Smith, Laurence L.** The teaching and practice of geology in South Carolina—Pt. 1, 1817–1912: South Carolina Div. Geology Geol. Notes, v. 12, no. 3, p. 39–66, 1968.

The principal personalities, some of their significant contributions, and episodes in the growth of teaching and practice of geology in the State are presented. Biographies of 16 men are included.—ESL

04774 **Smith, Patsy B.; Durham, David L.** Middle Miocene Foraminifera and stratigraphic relations in the Adelaida quadrangle, San Luis Obispo County, California: U.S. Geol. Survey Bull. 1271-A, p. A1-A14, illus., table, 1968.

The Salinas Valley region contains the type areas of the Monterey Shale and the Santa Margarita and Pancho Rico Formations, as well as the type areas of the Relizian and Luisian Stages of Kleinpell. Only in and very near the Adelaida 7 1/2-minute quadrangle do strata representing all these stratigraphic units crop out in close proximity. In addition, beds that contain fossil marine mollusks of Paleocene age crop out in the quadrangle. Of particular significance in Coast Range stratigraphy are the wide range in Tertiary age of fossils found in the Adelaida quadrangle and the geographic position of the quadrangle between the type areas of the Relizian and Luisian Stages of Kleinpell.—Authors' abstract

05122 **Smith, R. L.; Bailey, R. A.** Stratigraphy, structure, and volcanic evolution of the Jemez Mountains, New Mexico [abs.], *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 259-260, 1968.

04808 **Smith, Stewart W.** Memorial—Hugo Benioff (1899-1968): Seismol. Soc. America Bull., v. 58, no. 5, p. 1701-1703, portrait, 1968.

Smith, Stewart W. *See* Davies, John B. 04825

04771 **Smith, William H.** A geochemical investigation of a portion of the Fortymile district, east-central Alaska: Alaska Div. Mines and Minerals Geochem. Rept. 16, 17 p., illus., tables, 1968.

The purpose of the investigation was to do detailed geochemical stream sediment sampling in and near the Chicken mining camp, an area only partly covered by a previous report (Saunders, ibid., Rept. 9, 1966). The area covered includes the drainage of 16 creeks and portions of Mosquito and South Forks of the Fortymile River. A total of 176 stream sediment samples were taken, of which 25 had probable or possible anomalous concentrations of copper, zinc, lead, molybdenum, or nickel. Limited bedrock sampling, including possibly mineralized veins, was undertaken; 26 samples were selected for assay or analysis (results are tabulated). Three areas are worthy of more detailed investigation.—*from* Author's abstract

05005 **Smylie, D. E.; Mansinha, L.** Earthquakes and the observed motion of the rotation pole: Jour. Geophys. Research, v. 73, no. 24, p. 7661-7673, illus., table, 1968.

An observational test is made of the hypothesis that large earthquakes excite the Chandler wobble and produce the observed secular polar shift. This hypothesis was advanced on the basis of theoretical calculations using the elasticity theory of dislocations to represent displacement fields and earthquake statistics to estimate cumulative effects. Strong evidence to support the hypothesis is found in the pole paths observed over the last decade.—Authors' abstract

04602 **Sohn, I. G.** Memorial to Horace Noble Coryell (1888-1965): Geol. Soc. America Proc. 1966, p. 211-214, portrait, 1968.

04877 **Sohn, I. G.** Premature citations and zoological nomenclature: Science, v. 159, no. 3813, p. 441-442, 1968.

Examples are cited to show how premature citation of zoological (including paleontological) names and use of names in unpublished reports serve only to confuse the zoological nomenclature.—DBV

Sörensen, H. *See* Semenov, E. I. 04701

04863 **Sornay, Jacques.** Lexique stratigraphique international—V. 8, Termes stratigraphiques majeurs, Article Aptien: Paris, Centre Nat. Recherche Sci. (for Union Internat. Sci. Géol., Comm. Stratigraphie), 109 p., 1968.

The lower and upper limits of the Aptian, its zonation in different parts of the world, and zonation based on belemnids, cephalopods, and foraminifera are discussed. Other chapters cover the distribution and characteristics of the Aptian in France and its general characteristics in the world. The latter chapter is divided into sections covering four divisions of Europe; Asia; Africa; Australia, New Zealand, and Oceania; the American continent, North and South; and Arctic and Antarctic regions, including Greenland.—ESL

05162 **Sproule, J. C.; Edgington, A. N.; Cleland, N. A.** The present and future of oil and gas in Canada: Jour. Canadian Petroleum Technology, v. 7, no. 3, p. 91–97, illus., 1968.

The oil and gas industry in Canada is the largest single source of mineral income in the country, in excess of one billion dollars a year, supplying over 70 percent of Canada's energy requirements. Due to geographic, economic, industrial, and political considerations, the large volume of Canadian oil and gas that is exported to the United States amounts to something less than the total imports. With Canadian energy requirements expected to grow at 4.5 percent per year and percentage supplied by oil and gas to remain at the present level, production will treble in the next 25 years. Reserves needed to provide this will not all be developed in the western Canada basin, but will be found in the Arctic Islands area, basins off the east and west coasts of Canada, and in the Athabasca oil sands. The Arctic and offshore production should be able to compete in world markets.—GDC

Stainton, M. *See* Harriss, Robert C. 04893

Stehli, F. G. *See* Helsley, C. E. 04687

Steiger, R. H. *See* Hart, S. R. 04566

Stephens, F. R. *See* Patric, J. H. 04987

Sternberg, Yaron M. *See* Meinschein, W. G. 05107

05096 **Steuerwald, B. A.; Clark, D. L.; Andrew, J. A.** Magnetic stratigraphy and faunal patterns in Arctic Ocean sediments: Earth and Planetary Sci. Letters, v. 5, no. 2, p. 79–85, illus., 1968.

Magnetic reversal data from T-3 cores indicate a sedimentation rate of 1.0 to 2.6 mm per 1,000 years for the last 4 million years. Foraminifera and associated detritus suggest that the Arctic has not been warmer than at present for at least 1.5 million years. There is some correlation between Foraminifera distribution and magnetic reversal boundaries, but the meaning of this is not understood.—Authors' abstract

05117 **Steven, Thomas A.; Lipman, Peter W.** Central San Juan cauldron complex, Colorado [abs.], *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 209, 1968.

05121 **Steven, Thomas A.; Epis, Rudy C.** Oligocene volcanism in south-central Colorado, *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 241–258, illus., 1968.

Recently available K-Ar age determinations indicate that most of the volcanic rocks in the San Juan, West Elk, Thirtynine Mile, and Silver Cliff-Rosita Hills volcanic fields in south-central Colorado were erupted during Oligocene time, and probably once were parts of a single large composite field. This field was fragmented by block faulting and attendant erosion in Miocene and later time. Although present data are insufficient to permit accurate estimation of the former extent of the field, it must have covered most of south-central Colorado and adjacent parts of New Mexico.—Authors' abstract

04737 **Stevenson, I. M.** Geology of Lac Joseph map-area (23A), Newfoundland and Quebec: Canada Geol. Survey Paper 67-62, 4 p., geol. map, 1968.

The Lac Joseph area in the Grenville Province is underlain mainly by a metamorphosed sequence of quartzo-feldspathic and aluminous gneissic rocks intruded by gabbro and anorthosite. Metamorphism ranges from epidote-amphibolite facies to granulite facies; most gneisses occur as amphibolite assemblages characterized by garnet and/or sillimanite. Multiple deformations have compressed the gneisses into complex, steeply dipping to locally overturned, tight folds. Anorthositic and gabbroic rocks, less intensely deformed, are commonly massive with faint layering visible. The entire area has been extensively faulted but glaciation has removed or obscured most evidence. Several small showings of pyrite, chalcopyrite, and pyrrhotite in the gneisses are not of economic importance. Effective prospecting is hindered by thick drift.—*from* Author's abstract

05079 **Stevenson, John S.; Colgrove, Gordon L.** The Sudbury irruptive—Some petrogenetic concepts based on recent field work, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 4, Geology of Precambrian: Prague, Academia, p. 27-35, illus., 1968.

The Sudbury nickel irruptive contains the largest known concentration of nickel-copper sulfide ore in the world and for that reason geological uniqueness of the rocks of the irruptive is suggested. Work in recent years has shown that these rocks comprise a layered complex in which the layering is gross and can only be brought out by detailed mapping and petrographic study. This work has revealed no evidence of cross-cutting or intrusive relations nor any chilled surfaces between the two principal layers of the irruptive, the micropegmatite and the norite. Recent studies suggest that assimilation by the uppermost member of the irruptive, the micropegmatite, has been important spatially, and that only a small proportion of the micropegmatite is truly magmatic. In contrast, the norite is almost wholly magmatically derived.—*from* Authors' abstract

Stewart, Ronald C. *See* Walker, William R. 04585

05163 **Stice, Gary D.; McCoy, Floyd W., Jr.** The geology of the Manu'a Islands, Samoa: Pacific Sci., v. 22, no. 4, p. 427-457, illus., tables, geol. maps, 1968.

The islands, Ta'u, Ofu, and Olosega, form the Manu'a group, and were built by volcanic activity along the crest of the easternmost portion of the ridge. On Ta'u Island, aa and pahoehoe flows of four types of basalt have built a volcanic shield more than 3,000 feet above sea level with a total thickness from the ocean floor of over 12,000 feet; dips of the flows average 20-25°. Summit collapse formed a caldera, which has been partially filled, and two rift zones radiate from it coinciding with the trend of the ridge. Geologic maps and cross sections are included for all the islands, and Pliocene to Holocene formations are described. Ofu and Olosega represent a complex of at least six volcanic cones, the history of which is similar to Ta'u. A submarine eruption was reported between Olosega and Ta'u in 1868.—ESL

05111 **Stone, Oliver L.** Legal aspects of offshore oil and gas operations: Nat. Resources Jour., v. 8, no. 3, p. 478-504, 1968.

The 13 original colonies of the United States retained title to the beds and subsoil under their respective navigable waters; this ownership applies to all States subsequently entering the Union, and extends to tidelands, including rights to mineral resources therein. In the 1930's, with their emerging oil and gas potentialities, California asserted ownership of the submerged marginal belt extending 3 English miles seaward from low-water mark. Then began a long judicial-legislative struggle between the Federal government and several coastal States. Devolopments are reviewed in its resolution: the Federal government decreed to be possessed of paramount rights in and full dominion and power over the lands, minerals and other things underlying the offshore waters, to the extent of 3 marine miles off California, 27 off Louisiana, and to outer edge of continental shelf off Texas.—GDC

04873 **Streten, N. A.; Wendler, G.** The midsummer heat balance of an Alaskan maritime glacier: Jour. Glaciology, v. 7, no. 51, p. 431-440, illus., 1968.

The heat balance of an Alaskan mountain glacier located close to the sea is calculated for a period of 16 d in midsummer—a period which is typical of the summer in this region in its high cloudiness and in its temperature and humidity conditions. The radiative and the combined sensible and latent heat components are found to contribute equally to the observed high rate of ice melting.—Authors' abstract

04984 **Sturges, David L.** Hydrologic properties of peat from a Wyoming mountain bog: Soil Sci., v. 106, no. 4, p. 262–264, illus., table, 1968.

Peat from a Wyoming mountain bog was sampled at depths of 0–13, 13–25, and 36–48 cm. The bulk densities were 0.160, 0.208, and 0.216 g/cc, respectively. Water yields were 0.223, 0.140, and 0.076 cc/cc between saturation and 0.10 bar suction and 0.500, 0.458, and 0.349 cc/cc between saturation and 1.00 bar suction. The surface peat contained large voids which emptied at low suctions. Greater suctions were required to drain the smaller pores of the deeper material.—JWH

04642 **Sugimura, Arata.** Spatial relations of basaltic magmas in island arcs, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 2 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 537–571, illus., tables, 1968.

A review of the geophysical features of island arcs, differences in basaltic magmas along the fronts of the eastern and western volcanic belts of Japan, and other general features of the distribution of seismic activity and volcanic products leads to the conclusion that generation of basaltic magmas and occurrence of intermediate earthquakes represent different expressions of phenomena originating from a common source of energy.—MS

Swainbank, I. G. *See* Hills, F. Allan. 05055

04867 **Tandon, S. N.; Wasson, John T.** Gallium, germanium, indium, and iridium variations in a suite of L-group chondrites: Geochim. et Cosmochim. Acta, v. 32, no. 10, p. 1087–1109, illus., tables, 1968.

Replicate neutron-activation determinations of Ga, Ge, In, and Ir have been carried out in 26 members of the L-group chondrites. Indium varies from a high of 55 ppb in Hallingeberg to a low of 0.048 ppb in Peace River. The In concentrations are strongly correlated with those of primordial Ar-36 and Xe-132, total C, and with the degree of inhomogeneity of the ferromagnesium silicates. Concentrations of Ga, Ge, and Ir, are not correlated with petrologic type, nor with In or rare gas concentration. These elements are positively correlated with the Ni and metallic Fe contents of the meteorites, and negative correlations are found between the concentrations of Ga, Ir, Ni, and metallic Fe and the Fe/Fe + Mg ratios of the olivine. A model is proposed which accounts for the observations.—*from* Authors' abstract

04742 **Tapper, M.; Fanning, D. S.** Glauconite pellets—Similar X-ray patterns from individual pellets of lobate and vermiform morphology [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 4, p. 275–283, illus., tables, 1968.

Both forms of glauconite pellets occur together in Eocene formations in Maryland. The vermiform pellets appear identical to those previously called altered biotite, and in thin section show micaceous morphology. Some zones appear to be crystals, nearly rectangular in cross section. Externally, the lobate pellets have many rounded lobes and in thin section have a grainy appearance, indicating that they are composed of many small zones. Within the zones, glauconite has a single orientation, but the zones are not lined up to give a micaceous appearance. X-ray diffraction patterns of vermiform and lobate pellets are nearly identical. The K_2O content and CEC also indicate that interstratified expanded layers are present. The probability that both types obtained their morphology before or during the time they became glauconite suggests that the proper environment may form glauconite from a variety of starting materials.—*from* Editor's abstract

04671 **Tarakanov, R. Z.; Leviy, N. V.** A model for the upper mantle with several channels of low velocity and strength, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687) p. 43–50, illus.,, 1968.

A layered model for the structure of the upper mantle is proposed which provides a correlation between maximum earthquake magnitudes and the velocities and amplitudes of *P* waves. Four layers of low velocity and strength are distinguished within the upper mantle at depths of 60–90, 120–160, 220–300, 370–430 km, respectively. As a consequence of this model, the areas most favorable to the formation of magma are the regions where the low-velocity layers are cut by abyssal frracture zones.—Authors' abstract

05054 **Taylor, Hugh P., Jr.; Coleman, Robert G.** O-18/O-16 ratios of coexisting minerals in glaucophane-bearing metamorphic rocks: Geol. Soc. America Bull., v. 79, no. 12, p. 1727–1755, illus., tables, 1968.

The oxygen isotope fractionations among coexisting minerals in a variety of rock types metamorphosed to the blueschist facies in California, Oregon, and New Caledonia are systematic and larger than those measured in pelitic schists of the biotite zone. Using the calibrated quartz-muscovite and quartz-$CaCO_3$ geothermometers, the measured quartz-muscovite and quartz-aragonite fractionations indicate temperatures of formation for the medium-grade glaucophane schists (quartz-muscovite, glaucophane, lawsonite, garnet, chlorite, aragonite, ilmenohematite) of 270° to 315°C. Higher-grade glaucophane schists and associated eclogites were recrystallized at temperatures 400° to 550°C. Temperature of metamorphism of the lower-grade rocks that contain lawsonite, aragonite and glaucophane give 200° to 270°C.—AH

Taylor, Paul B. *See* Benavides, Victor E. 04612

05126 **Taylor, Richard B.; Theobald, Paul K.; Izett, Glen A.** Mid-Tertiary volcanism in the central Front Range, Colorado, *in* Cenozoic volcanism in the southern Rocky Mountains: Colorado School Mines Quart., v. 63, no. 3, p. 39–49, illus., table, 1968.

The occurrence within the Front Range mineral belt of mid-Tertiary igneous rocks and the spatial and genetic relationship of the Red Mountain stock to the molybdenum deposit of the Urad mine demonstrate that a second important period of mineralization occurred in the Front Range during the Oligocene, considerably later than the well-publicized Laramide ore-forming events. By correlating rock alteration patterns, geochemical associations of key elements, and ore and porphyry types, additional mid-Tertiary intrusives and ore deposits can be identified with reasonable certainty within the belt of activity hallowed as "Laramide." Hypotheses based on two periods of intrusion and mineralization harmonize many conflicting points of geologic data within the mineral belt.—*from* Authors' summary

04677 **Teichert, Curt.** Nekotoryye biologicheskiye i paleogeograficheskiye faktory otsenki klimatov proshlogo, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 382–385, illus., 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7-12, 1963.—DBV

04814 **Thayer, T. P.; Himmelberg, G. R.** Rock succession in the alpine-type mafic complex at Canyon Mountain, Oregon *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 1, Upper mantle (geological processes): Prague, Academia, p. 175–186, illus., table, 1968.

The Canyon Mountain Complex in northeastern Oregon comprises rocks ranging from podiform chromite deposits in dunite to albite granite. The complex intrudes metavolcanic and sedimentary rocks of Permian age and is unconformably overlain by graywackes of Late Triassic and Jurassic age; it consists mainly of alpine-type

olvine-rich peridotite and gabbroic rocks which intergrade. The gabbroic rocks form a continuous series from feldspatic peridotite to quartz-rich hypersthene gabbro. The gabbroic part of the complex has been intruded by a few small masses on trondhjemite and the border zone is cut by numerous elongate masses of albite granite. Although the trondhjemite and albite granite were not chilled against gabbro, the basaltic dikes having chilled margins show that the three rocks cannot have been differentiated continuously in place.—*from* Authors' abstract

Theisen, A. A. *See* Borchardt, G. A. 04810

Theobald, Paul K. *See* Taylor, Richard B. 05126

05080 **Thomas, Grant W.; Yaron, Bruno.** Adsorption of sodium from irrigation water by four Texas soils: Soil Sci., v. 106, no. 3, p. 213–219, illus., tables, 1968.

The authors conclude that when water containing sodium first flows through soil columns, the relationship between sodium adsorption ratio of water and the exchangeable sodium percentage of soil does not give a significant correlation, except at the surface. Soils containing both mica and montmorillonite have a higher affinity for Na than do the montmorillonite soils. The continuous change in soil hydraulic conductivity until a constant Na percentage is achieved along the soil column makes it difficult to predict the flow of water in field conditions from equilibrium hydraulic conductivity.—JWH

05146 **Thomas, Josephus, Jr.; Bohor, Bruce F.** Surface area of montmorillonite from the dynamic sorption of nitrogen and carbon dioxide [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 1, p. 83–91, illus., tables, 1968.

Surface area determinations were made on a montmorillonite, using nitrogen and carbon dioxide as adsorbates at 77° and 195°K, respectively, in a dynamic system. With nitrogen, surface areas ranged from 61 m^2/g for Li-montmorillonite to 138 m^2/g for Cs-montmorillonite, reflecting some nitrogen penetration between layers. The extent is time-dependent and is also a function of the interlayer forces governed by the size and charge of the replaceable cation. With carbon dioxide, surface values ranged from 99 m^2/g for Li-montmorillonite to 315 m^2/g for Cs-montmorillonite. Although the carbon dioxide molecule is larger, its greater penetration appears to be a result of its being kinetically more energetic at its higher adsorption temperature.—*from* Editor's abstract

Thompson, T. D. *See* Lailach, G. E. 04743

04999 **Thompson, Will F.** New observations on alpine accordances in the western United States: Assoc. Am. Geographers Annals, v. 58, no. 4, p. 650–669, illus., 1968.

Photointerpretive reconnaissance of the higher mountains of western United States indicates that alp slopes coincide with present timberlines and that a *gipfelflur* occurs about 600 meters above that level. Few peaks, other than volcanic cones, rise to significant heights above the *gipfelflur*, which is interpreted as the topographic record of an interglacial timberline 600 meters above that of today. The present alp slope is interpreted as the lower limit of effective control of mass wasting processes by timberline, and the level at which alpine frost processes are replaced as the dominant geomorphic activity at timberline by alpine glaciations (or vice versa) during each fluctuation of Quaternary glacial climates.—*from* Author's abstract

04798 **Thomson, Keith Stewart.** A new Devonian fish (Crossopterygii: Rhipidistia) considered in relation to the origin of the Amphibia: Postilla, no. 124, 13 p., illus., 1968.

Hyneria lindae, gen. et sp. nov., is a large rhizodontid rhipidistian fish from the Upper Devonian (Oswayo Formation) of [Clinton County] Pennsylvania. It shows a remarkable similarity to the intermediate stages that must have preceded the first true Amphibia. The similarity is due to the parallel evolution of rhizodontid Rhipidistia and the Amphibia from a common stock in the Middle or early Late Devonian.—Author's abstract

05091 **Tien, Pei-Lin.** Differentiation of Pleistocene deposits in northeastern Kansas by clay minerals [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 1, p. 99–107, illus., tables, 1968.

Seventy-four samples from eight stratigraphic sections of lower Pleistocene glacial and glaciofluvial deposits in Doniphan County, extreme northeastern Kansas, were analyzed using X-ray diffraction techniques. Clay-mineral assemblages of the <2μ fraction of these deposits are nearly identical, consisting of a mixed-layer clay mineral associated with minor amounts of kaolinite and illite. An attempt was made to differentiate units of till and nontill deposits by using the relative intensities of 001 reflections of "mixed-layer mineral," kaolinite, and illite. At least two tills were recognizable. Associated nontill deposits could not be differentiated from one another, although the nontills are easily distinguished from tills.—Author's abstract

05084 **Tilling, Robert I.** Zonal distribution of variations in structural state of alkali feldspars within the Rader Creek pluton, Boulder batholith, Montana: Jour. Petrology, v. 9, no. 3, p. 331–357, illus., 1968.

Available data suggest that the variations in structural state and the degree of unmixing observed for alkali feldspars of the Rader Creek pluton seem best explained by a mechanism of primary disequilibrium cooling, coupled with secondary adjustments in structural state caused by reheating associated with the intrusion of adjacent younger intrusives.—*from* Author's summary

Tilton, G. R. *See* Hart, S. R. 04566

Timberlake, L. L. *See* Voloshin, V. 05041

Tipper, H. W. *See* Jeletsky, J. A. 04727

04892 **Tite, M. S.** Some complicating factors in thermoluminescent dating and their implications, Chap. 7.3 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 389–405, illus., tables, 1968.

The principal use of thermoluminescence today is in absolute radiation dosimetry, through which the vital connection with natural radioactivity is established. The combination of radiation dosimetry with the irradiation-rate process makes age dating and, in part, geothermometry possible. A better means of high quality dosimetry would supercede thermoluminescence, in which accuracy is limited by radiation damage, usually when total dosage exceeds 10^5 r; this would limit simple thermoluminescent dosimetry to post-Pliocene rocks and minerals. A dating tool is urgently needed for the 10^4–10^5 year period of the Pleistocene–Pliocene where no isotope methods can be applied. Basic validity of the thermoluminescent dosimetry method is demonstrated in the author's study of calcitic fossils (1966,1967), where radiation dose rates determined from natural thermoluminescence agree well with those calculated from radioactivities.—GDC

04750 **Tomura, Teruichi; Okano, Hiroshi; Hara, Koichi; Watanabe, Tadao.** Multistep intensity indication in scanning microanalysis, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 316–325, illus., 1968.

Improvements on semiquantitative analysis have been attained by development of a new *content mapping* attachment, by use of which the X-ray intensity is indicated on a cathode-ray tube in nine steps of brightness. The image is composed of 2,500 picture elements, the brightness of which corresponds to an exponentially modulated X-ray intensity from the corresponding point on the specimen. On typewritten paper, the intensity is indicated by numbers, each printed in a different color to form a contour map of element distribution. A complete contour map can be done in about 8.5 minutes.—*from* Authors' abstract

Toothacker, William S. *See* Preuss, Luther E. 04751

Tozer, E. T. *See* Silberling, N. J. 04891

04712 **Tremblay, J.-J.** La géochimie de l'eau souterraine de la region de Beloeil [with English abs.]: Geol. Assoc. Canada Proc., v. 19, p. 50–56, illus., 1968.

Eighty-nine ground-water samples from the Beloeil area of Quebec were analyzed chemically and the data was plotted on Piper and Schoeller diagrams. The data indicate that the evolution of ground water in this region is normal and that the waters go through three successive stages: hard, soft, and saline.—*from* Author's abstract

04793 **Tri-State Geological Field Conf.; LaBerge, Gene L.; Weis, Leonard W.; Dutton, Carl E.** A greenstone belt in central Wisconsin?—Tri-State Geol. Field Conf., 32d Ann., 1968, Guidebook: [Oshkosh, Wis., Wisconsin State Univ.-Oshkosh] 42 p., illus., geol. maps, 1968.

The short geologic history of Wisconsin introducing the guidebook covers Precambrian to Devonian time and the glaciation. Seven pages of text preceding the road logs discuss the lithology, relative age, absolute age, and economic significance of greenstone belts. The proposed belt may be 1,000 million years younger than those in the Canadian Shield. Most greenstone belts in the Shield contain important sulfide deposits. A statement at each stop on the road log points out its relevance to the proposed greenstone belt; greenstones are described in some detail. A geologic map of Marathon County, and two geologic sketch maps are included.—ESL

05144 **Uchupi, E.** Long lost Mytilus: Oceanus, v. 14, no. 3, p. 2–7, illus., 1968.

Seismic surveys show an impressive belt of large conical peaks, the New England Seamount Chain, also known as the Kelvin Seamounts, extending from the continental slope south of Georges' Bank to the northern edge of the Bermuda Rise; it has been suggested that they are aligned along the Kelvin fault. The seamounts, rising abruptly from depths of 1,600–4,000 m, have single or multiple peaks rather than flat tops and appear to consist of basalt. Mytilus Seamount is truncated by a strong internal reflecting horizon, probably representing an erosional surface, indicating that it was near the surface at one time; the mound above this, from which Eocene algae were dredged, appears to be an organic reef. Strata surrounding the seamounts are Cretaceous and younger and show no signs of intrusion, suggesting a Triassic or Jurassic age for the seamounts.—ESL

Uchupi, Elazar. *See* Zarudzki, E. F. K. 05050

05017 **Urban, James B.** *Dibrochosporites*, a new sporomorph from the Middle Devonian of Iowa: Micropaleontology, v. 14, no. 3, p. 371–373, illus., 1968.

Palynologic fossils considered to represent a new taxon have been recovered from rocks of the Cedar Valley Formation (Middle Devonian) of Winneshiek County, Iowa. The scanning electron microscope has revealed details of morphology not readily discernible in transmitted light miccroscopy. The new genus *Dibrochosporites* and the new species *Dibrochosporites nodosus* are erected for these fossils.—Author's abstract

04881 **U.S. Bureau of Mines.** Prospecting and exploring for radioactive minerals—Supplement to facts concerning uranium exploration and production: U.S. Bur. Mines Inf. Circ. 8396, 36 p., 1968.

This is a compilation concerning the geology of radioactive mineral deposits and geophysical techniques up to 1955 and a more timely outline of information about geochemical exploration, ways of acquiring mining rights, and the developing market for uranium.—APB

04838 **U.S. Geological Survey.** Geological Survey research 1968, Chap. A: U.S. Geol. Survey Prof. Paper 600-A, p. A1–A371, illus., 1968.

The annual review of economic and scientific work of the U.S. Geological Survey includes resources investigations; geologic and hydrologic principles, processes, and techniques; geology and hydrology applied to engineering and the public welfare; astrogeology; remote sensing and advanced techniques; geologic and hydrologic investigations in other countries; topographic surveys and mapping; computer technology; publications program; cooperators and other financial contributors during fiscal year 1968; U.S. Geological Survey offices; investigations in progress in the Geologic, Water Resources, and Conservation Divisions; contents of Geological Survey research 1968, Chapters B, C, and D; and publications by Survey authors in fiscal year 1968, with index. Subject and investigator indexes for the entire volume are included.—MCM

05006 **Vaišnys, J. Rimas.** Propagation of acoustic waves through a system undergoing phase transformations: Jour. Geophys. Research, v. 73, no. 24, p. 7675–7683, 1968.

The propagation of a sound wave through a system in which phase transformations are possible is examined. Dispersion and attenuation of the wave are found if the wave frequency is comparable to the reaction rate. Sharp changes in the phase velocity and relative energy loss per cycle are expected when phase boundaries are crossed. The attenuation due to a phase transformation can be sufficiently large to contribute to seismic losses in the mantle.—Author's abstract

04586 **Valencia, Shirley M.** New Alaskan gold rush?: Sea Frontiers, v. 14, no. 5, p. 308–314, illus., 1968.

Geologists using sophisticated scientific approaches are moving out into Alaskan seas, seeking gold and other valuable minerals in the sediments of bays, fiords, and the continental shelf. A program, instigated by the U.S. Geological Survey to explore for heavy minerals along the eastern Gulf of Alaska from Kayak Island to Cape Spencer, has explored for valuable minerals with a grab sampler, examined the glacio-marine sedimentary environment, and recorded the bottom topography.—ESL

Vali, V. *See* Bostrom, R. C. 05104

Vand, V. *See* Johnson, G. G., Jr. 04756

05046 **VanDenburgh, A. S.** Chemical quality of the ground water, *in* Ground-water resources of Island County, Washington: Washington Dept. Water Resources Water Supply Bull. 25, pt. 2, p. 22–47, illus., tables, 1968.

The chemical quality of ground water in Island County has been evaluated by laboratory and field analyses. Deposits forming the two islands contain ground water of three contrasting chemical types. Throughout much of the county the water contains only 100–300 mg/l of dissolved solids, but water from the Coupeville–Oak Harbor area and the Brown Point lowland contains 300 to over 1,000 mg/l of solids. Along the shorelines, ground water of either variety may be contaminated by salt water. Well owners' reports of noticeable iron are included in the well records given in an appendix. Seasonal and long term changes of quality and problem areas are outlined. A map shows chloride content, hardness, and specific conductance of ground water.—ESL

04830 **VanHorn, Richard.** Physical property and construction use data sheet for surficial deposits: Assoc. Eng. Geologists Bull., v. 5, no. 1, p. 18–22, tables, 1968.

The data sheet was compiled so that engineering experience of several federal agencies would be readily available to geologists involved in construction. A table gives field identification procedures for unified soil classification. The data sheet will be of most use in a field situation. To use it, select the proper soil class and follow the horizontal row to the column that gives the property or use sought. The number at this intersection indicates the value for that property or use relative to the other classes.—ESL

04680 **VanHouten, F. B.** Nekotoryye nereshennyye problemy genizisa krasnotsvetov, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 421–434, 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

04581 **Vanoni, Vito A.; Hwang, Li-San.** Relation between bed forms and friction in streams—Closure [to discussion of paper 5242, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 6200, Jour. Hydraulics Div., no. HY6, p. 1524–1527, illus., 1968.

It is clear from the discussion that the assumption, upon which Eq. 7 and Fig. 5 are based, is only an approximation. A new graph of Eq. 4 suggests that it also may be approximate. The writers agree that the main stream is not in contact with the bed on the lee side of ripples and dunes. For ripple and dune beds, friction due to sand grain roughness is usually smaller than that due to bed forms. Semilogarithmic velocity profiles and values of k measured by Hwang are given in graphs, which show that flow over ripples is nonuniform; the physical significance of k values calculated for flows with high roughness no longer conforms to the original von Karman constant. Properties of the bed form depend upon sediment size and flow parameters, and the friction factor can be expressed in terms of these directly without determining the bed form geometry.—ESL

Vincent, H. A. *See* Volborth, A. 04749

05085 **Vine, Frederick J.** Evidence from submarine geology, *in* Gondwanaland revisited—New evidence for continental drift: Am. Philos. Soc. Proc., v. 112, no. 5, p. 325–334, illus., 1968.

The hypothesis of sea-floor spreading is outlined and supported by considerable evidence. The shallow-focus earthquakes along the oceanic ridges are loci where new crust is being formed from up-welling mantle, and the trench systems are regions where crust is being downwarped or resorbed. The continents are being separated by this spreading where it was initiated within a continental area, but the Pacific Ocean rise, while showing spreading, was probably initiated within a former oceanic basin. Rates of spreading can be calculated from the paleomagnetic reversals which are preserved. Sea-floor spreading is capable of explaining many of the first order structural features of the Earth's surface and is compatible with the results of geological and geophysical investigation of the ocean basins, and also provides an adequate mechanism for continental drift.—HRC

04802 **Vineyard, Jerry D.** Bibliography of the geology of Missouri, 1967: Missouri Div. Geol. Survey and Water Resources Inf. Circ. 19, 57 p., 1968.

The bibliography lists published and unpublished papers on the geology of Missouri that were issued in 1967, with a few earlier that were not included in previous bibliographies. The index is classified by counties and subject.—MCM

04630 **Vischer, G. A.** Memorial to Hans Peter Schaub (1912–1965): Geol. Soc. America Proc. 1966, p. 367–368, portrait, 1968.

Vokes, Emily H. *See* Vokes, Harold E. 05056

05057 **Vokes, Emily H.** Cenozoic Muricidae of the western Atlantic region—Pt. 4, *Hexaplex* and *Murexiella*: Tulane Studies Geology, v. 6, no. 3, p. 85–126, illus., 1968.

A total of 28 species of Muricidae are treated systematically. Of these, only two species of *Hexaplex* s.s. and four of *Murexiella* s.s. occur in the Holocene, and only three of these are confined to Holocene waters, the others having fossil representatives also. These genera are well represented in the Eocene but the respective subgenera do not appear until the Miocene. Seven new species are described, six from the Miocene and one from the Pliocene.—*from* Author's abstract

05056 **Vokes, Harold E.; Vokes, Emily H.** Variation in the genus *Orthaulax* (Mollusca: Gastropoda): Tulane Studies Geology, v. 6, no. 2, p. 71–79, illus., 1968.

A study of approximately 750 specimens of *Orthaulax gabbi* Dall, from the [Tertiary] Chipola Formation of northwestern Florida, reveals a high degree of variation in the spire height, spire angle, and nature of the cross-sectional outline of the shell. As these characteristics are the criteria upon which new species have been distinguished in the past it is probable that several of the existing taxa, if adequately known, would be found to be synonyms. The eleven described species of *Orthaulax* are listed with their stratigraphic occurrence. In addition, *O. gabbi* is discussed in greater detail and the color pattern of the species is figured.—Authors' abstract

04749 **Volborth, A.; Fabbi, B. P.; Vincent, H. A.** Total nondestructive analysis of CAAS syenite, *in* Advances in X-ray analysis, V. 11—Applications of X-ray Analysis, 16th Ann. Conf., Univ. Denver, 1967, Proc.: New York, Plenum Press, p. 158–163, tables, 1968.

Determination of 35 trace and 8 major elements in a granitic rock by X-ray emission and fast-neutron activation methods has been accomplished. The trace elements have been estimated in the vacuum X-ray spectrograph, as were major elements aluminum, calcium, iron, potassium, and silicon. Phosphorus has been excited by a chromium-target tube, and magnesium, sodium, and oxygen have been estimated by the Henke aluminum-target X-ray spectrograph. Oxygen and silicon also have been determined by fast-neutron activation. Detection limits for traces are in the range of 1 to 100 ppm with standard deviations of 1 to 10 ppm. Precision in determination of major elements is better than one percent in relative standard deviation. Data are reported in parts per million for both trace and major elements; this is preferable to reporting major constituents as oxides.—*from* Authors' abstract

05041 **Voloshin, V.; Nixon, D. D.; Timberlake, L. L.** Oriented core—A new technique in engineering geology: Assoc. Eng. Geologists Bull., v. 5, no. 1, p. 37–48, illus., 1968.

A core barrel permitting orientation of drill core was used successfully to determine subsurface conditions at the Oso Pumping Plant and Pyramid Power Plant sites of the California Aqueduct Project. At Oso, the foundation consists of 120 feet of sand terrace material underlain by deformed Pliocene lake-bed claystone, with zones of soft, highly plastic clay. Results indicated that the terrace material was strong enough to support the structure, but stability analyses through the claystone indicated failure. Oriented core provided a method of determining the attitude of weak zones. The Pyramid plant rests on underlying folded and faulted Pliocene shale covered by up to 60 feet of saturated alluvium in a swampy stream channel. The oriented-core method determined the location of a plunging syncline crossing the channel and helped determine safe cut slopes.—*from* Authors' abstract

Wagener, H. D. *See* Secor, D. T. 04728

04834 **Wagener, H. D.** Notes on metamorphic rocks of the eastern Piedmont of South Carolina—Winnsboro area: South Carolina Div. Geology Geol. Notes, v. 12, no. 2, p. 25–29, illus., 1968.

About 170 sq mi of metamorphic and plutonic rocks have been mapped in Fairfield County. The greenschist facies rocks, rocks of uncertain metamorphic rank, and almandine-amphibolite facies rocks, are divided into those of probable sedimentary, uncertain, and probable igneous origin. Most workers in the southeastern Piedmont agree that, even though fossils are rare, rocks were initially deposited as a marine-volcanic association. In the Winnsboro area the existence of sublittoral or transitional sublittoral to nonmarine conditions are suggested, and the possibility of subaerial deposition cannot be ruled out. The amphibolitic rocks are meta-igneous, and local centers of volcanic activity are suggested.—ESL

04643 **Wager, L. R.** Rhythmic and cryptic layering in mafic and ultramafic plutons, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 2 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 573–622, illus., 1968.

Layering is defined as a type of banding due to sequential deposition of igneous material either similar or different in composition. The characteristics and nomenclature of various types of textures and cumulus phases are discussed, and the Skaergaard (Greenland) and Bushveld (South Africa) intrusions are cited as striking examples of rhythmically layered masses characterized by cryptic variation resulting from crystal fractionation. Settling and bottom accumulation of crystals are generally considered responsible for layering, but details of the mechanism are not yet fully understood. Several suggestions are outlined, with the conclusion that internal mechanisms rather than external causes are probably principally responsible for layering.—MS

Wahl, Werner H. *See* Kramer, Henry H. 04706

Walker, Robert M. *See* Fleischer, Robert L. 04709

04585 **Walker, William R.; Stewart, Ronald C.** Deep-well disposal of wastes: Am. Soc. Civil Engineers Proc., v. 94, paper 6171, Jour. Sanitary Eng. Div., no. SA5, p. 945-968, illus., tables, 1968.

Deep-well disposal as a method for pollution control is investigated by states to ascertain the degree of development of deep-well disposal, and the procedures evolved to control this mode of disposal. Only 9 of the 45 states surveyed expressly prohibit or, as a matter of policy, actively discourage the method of deep-well disposal. Twenty-five states have some type of disposal wells presently in operation. The two controlling conditions necessary for an operable deep-well disposal system are a suitable disposal stratum, and a waste physically and chemically compatible with the resident material in the disposal formation. Care must be taken to assure that the various benefits are balanced, and that one aspect is not protected in such a manner as to be to the complete detriment of others.—Authors' abstract

Wall, David. *See* Evitt, William R. 04788

05013 **Wall, David; Dale, Barrie.** Modern dinoflagellate cysts and evolution of the Peridiniales: Micropaleontology, v. 14, no. 3, p. 265-304, illus., tables, 1968.

The resting cysts (spores) of over 30 species of modern marine and fresh water dinoflagellates belonging to the genera *Gonyaulax, Protoceratium, Peridinium, Diplopsalis, Diplopsalopsis, Diplopeltopsis,* and *Scrippsiella* are described morphologically and their systematic relationships with fossil dinoflagellates and hystrichospheres are discussed. These modern cysts were studied *in vivo* in North Atlantic phytoplankton at Woods Hole and in a series of over seven hundred single-cell incubation experiments. Fossil or subfossil cysts were also examined from Caribbean, Mediterranean, and western Arabian Sea sediments. It is concluded that modern resting cysts of thecate dinoflagellates are homologous with some fossil dinoflagellates and hystrichospheres and systematic morphological fluctuations follow patterns already known; and relations reflect evolution of the Peridiniales.—*from* Authors' abstract

Warkentin, John. *See* Canadian Association of Geographers. 05042

04741 **Warren, Doris C.; McAtee, James L., Jr.** A morphological study of selected synthetic clays by electron microscopy [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 4, p. 271-274, illus., 81968.

The morphology of synthetic montmorillonite and hectorite was studied using electron microscopy and X-ray diffraction techniques. Interstratified montmorillonite-mica particles may be identified by these methods. Magnesium-substituted samples were found to exhibit an increasing amount of curling with increasing magnesium content except for the end-member magnesium clay, Synthetic hectorite clays do not necessarily have the same morphology as natural hectorite clays. A study was made also of a series of samples obtained from a study of kinetics of crystallization. Boehmite and montmorillonite were the basic components of the system. It was found that the montmorillonite clay particles curled around the boehmite which had been adsorbed on the basal surfaces on the montmorillonite.—*from* Authors' abstract

Wasson, John T. *See* Tandon, S. N. 04867

Watanabe, Tadao. *See* Tomura, Teruichi. 04750

04764 **Waters, A. C.** Reconnaissance geologic map of the Madras quadrangle, Jefferson and Wasco Counties, Oregon: U.S. Geol. Survey Misc. Geol. Inv. Map I-555, scale 1:125,000, 1968.

Watkins, Joel S. *See* Godson, Richard H. 05038

05147 **Weaver, Charles E.** Relations of composition to structure of dioctahedral 2:1 clay minerals [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 1, p. 51–61, illus., 1968.

A ternary plot of the tetrahedral R^{3+} and octahedral R^{3+} populations for the dioctahedral 2:1 clay minerals shows a broad range of compositional variation within each of the major clay minerals. The clay minerals can be subdivided on the basis of total charge, location of the charge, and the relative amounts of Al and Fe^{3+} in the octahedral sheet. The division is natural and is controlled by the misfit between the tetrahedral and octahedral sheets and the need for tetrahedral rotation. The compositions of the tetrahedral and octahedral sheets are interdependent. Whereas muscovite has a lower limit of 1.7 Al octahedral occupancy, illite and montmorillonite have a lower limit of 1.3 Al; lower Al values result in the formation of a chain structure.—Author's abstract

Weichert, D. H. *See* Manchee, E. B. 05131

05022 **Weidick, Anker.** Observations on some Holocene glacier fluctuations in West Greenland: Medd. Grönland, v. 165, no. 6, 202 p., illus., tables, 1968; *reprinted in* Grönlands Geol. Undersögelse Bull. 73, 1968.

Historical and contemporary data record major and minor fluctuations of the Inland ice. Regardless of glacier type, fluctuations are mostly in phase and follow a delay of a few to 20 years after climatic changes. Dates of change are 1650(?), 1756(?), 1890, and 1920. Magnitude shows a regional variation, however. As a whole, the deposits of the historical glacier advances form a zone marking a single stage in the extent of the glaciers. Prehistoric ice margin stages of local glaciers have been less extensively investigated. In general, they indicate only late and slight development of local glaciers due, it is believed, to the glaciation limit at the time of the retreat of the continental glaciation being already too high for their widespread development.—*from* Author's abstract

Weis, Leonard W. *See* Tri-State Geological Field Conf. 04793

Welday, E. E. *See* Baird, A. K. 04746

Wells, John D. *See* Elliott, James E. 05159

Wendler, G. *See* Streten, N. A. 04873

05029 **Wertz, Jacques B.** Structural elements of ore search in the Basin and Range Province, southeast Arizona—Domes and fracture intersections: Soc. Mining Engineers Trans., v. 241, no. 3, p. 276–291, illus., 1968.

Detailed structural studies in southeast Arizona have revealed: the local attitudes of individual fractures (with lateral and/or vertical displacements), the patterns exhibited by groups of fractures, and the trends and directions shown by fracture groups or zones on a regional scale. The results of the studies have been twofold: First, domes were locally determined from these fracture arrangements; and, second, fundamental breaks brought out the breadth of the Texas lineament in southeast Arizona as well as major northwest- and northeast-trending fracture zones. Coincidence of one or several domes with major intersections of fundamental breaks can be centers of important mineralization, as at Bisbee, Ajo, and Morenci.—*from* Author's abstract

White, E. W. *See* Hach, J. T. 04753

04601 **White, George W.** Memorial to J. Ernest Carman (1882–1966): Geol. Soc. America Proc. 1966, p. 205–210, portrait, 1968.

White, John A. *See* Downs, Theodore. 05061

04796 **White, Theodore E.** Dinosaurs at home: New York, Vantage Press, 232 p., illus., 1968.

This book was written for pre-college teenagers interested in dinosaurs by the paleontologist in charge at the Dinosaur National Monument in northeastern Utah. It includes: a history of recovery work at the quarry; general geology of the area, particularly of the Jurassic Morrison Formation, which contains the bone-bearing layer; an interpretation of Jurassic paleoclimatology and paleoecology of the area, including the plants and animals associated with the dinosaurs; restorations, classification, and functional morphology of the dinosaurs in the area; and evolution and worldwide geographic distribution of the main groups of dinosaurs.—VMJ

04670 **White, W. R. H.; Bone, M. N.; Milne, W. G.** Seismic refraction surveys in British Columbia, 1941–1966—A preliminary interpretation, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 81–93, illus., 1968.

Evidence for and against large upper mantle velocity variations is summarized. Two models are suggested, both of which support upper mantle velocities in the neighborhood of 8.0 kmps. One postulates undulation of the mantle-crust boundary of the order of several kilometers and allows for small though relatively insignificant changes of mantle velocity throughout the region. The other postulates northward and westward crustal thinning and is restrained to a more uniform mantle velocity.—MS

04624 **Whitmore, Frank C., Jr.** Memorial to Albert Williams Postel (1909–1966): Geol. Soc. America Proc. 1966, p. 3441–346, portrait, 1968.

04658 **Whitten, Charles A.** Geodetic measurements of the study of crustal movements, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS-NRC Pub. 1687), p. 342–345, 1968.

A type of analysis is proposed for determining the pattern of crustal changes throughout a given region subjected to deformation, which involves calculation of a three-dimensional mathematical model with a fourth parameter for time.—MS

05133 **Wilhjelm, J.** Non-random influence of external sources on a geomagnetic induction anomaly in the northern part of Greenland: Royal Astron. Soc. Geophys. Jour., v. 16, no. 3, p. 269–273, illus., table, 1968.

Vectors representing changes in the geomagnetic field often tend to lie in or close to a plane and for coastal observatories this plane almost invariably tilts upwards toward the nearest deep ocean. A similar effect exists in Greenland at the Nord station close to the Polar Basin. The orientation of the preferred plane depends not only on the frequency spectrum of the geomagnetic variations, but also on the directional and nonrandom characteristics of the external sources. At Nord these nonrandom characteristics lead to a diurnal variation in the orientation of the preferred plane which amounts to as much as 15° in tilt and 40° in azimuth. The concept of a "magnetic activity ellipsoid" is introduced as a useful technique for analyzing changes in the magnetic field.—DBV

04616 **Willard, Bradford.** Memorial to Dean Benjamin McLaughlin (1901–1965): Geol. Soc. America Proc. 1966, p. 293–295, portrait, 1968.

04607 **Williams, M. Y.; Johnson, Helgi.** Memorial to Albert Orion Hayes (1882–1965): Geol. Soc. America Proc. 1966, p. 233–239, portrait, 1968.

Williams, R. E. *See* Jones, R. W. 04853

Willman, H. B. *See* Frye, John C. 04839

05087 **Wilson, J. Tuzo.** Static or mobile earth—The current scientific revolution, *in* Gondwanaland revisited—New evidence for continental drift: Am. Philos. Soc. Proc., v. 112, no. 5, p. 309–320, illus., table, 1968.

The outer layer of the Earth, the lithosphere, is proposed to be composed of a series of plates, the interaction between which is the cause of earthquakes, mobile belts, and other large-scale, worldwide phenomena. Three types of mobile belts occur at the junctions of the plates where they slide past one another, move apart, or come together. Time and motion studies indicate that the ocean basins must have undergone life cycles, several of which are outlined. Mountains are a product of blocks coming together. The history of the eastern United States, the Arctic Ocean basin, and the Cordillera are cited as examples of the general theory. Exhortation for the study of the Earth with this background is suggested, rather than having fixed continents or studying each plate alone.—HRC

04815 **Wilson, Robert.** Insectivores, rodents and intercontinental correlation of the Miocene, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 10, Tertiary-Quarternary boundary: Prague, Academia, p. 19–25, table, 1968.

Almost all of the useful faunal elements for mammalian intercontinental correlation in 1947 were perissodactyls and proboscideans, with a few carnivores in addition. Even so, approximate correlation seemed possible between Europe and North America for stages of the Miocene. A whole series of genera of insectivores and rodents are now claimed to be present in both Europe and North America. At present, these new elements have not produced much strengthening of the basis for Miocene correlation.—KAF

05011 **Winder, C. Gordon.** Stratigraphic variability of Middle Ordovician conodonts at Lakefield, Ontario [with French abs.]: Geol. Assoc. Canada Proc., v. 19, p. 92–99, illus., table, 1968.

The quarry at Lakefield, Ontario, exposes 46 feet of flat-lying, thin bedded, fossiliferous micrite and sparite and thin intercalated shale of the Middle Ordovician Trenton Group. A change in lithology occurs 17 feet from the top of the quarry above which argillaceous content, micrite, and megafossil content decrease, and carbonate content increases. More than 20,000 conodonts were identified and 22 genera recognized. The coincidence of lithologic and faunal change suggests that environment had an influence on conodont distribution. Comparison with the standard Trenton section suggests the quarry rocks lie near the Shoreham–Denmark boundary of New York. Presumably they belong to the Barneveld Stage, however, direct correlation by conodonts is tenuous because strata of this age in New York have a European fauna whereas a Mid-Continent fauna occurs at Lakefield.—*from* Author's abstract

04807 **Winkler, Erhard M.** Frost damage to stone and concrete—Geological considerations: Eng. Geology—Internat. Jour., v. 2, no. 5, p. 315–323, illus., table, 1968.

Frost action on natural rock, structural stone and concrete does not depend on the expansion of ice alone but on a combination of the following: the actual process of freezing connected with the pressure-volume-temperature diagram of ice, water transportation to the zone of freezing and water behavior in microcapillaries, and lithologies which promote frost action. The frost sensitivity of rocks and concrete depends upon rock strength, temperature, and lithology. Geologic factors which must be considered include ice in geologic thermometry to determine the length of prolonged exposure to temperatures below freezing; pressure melting of ice, that is, the effect of point-bearing piles in permafrost areas; and ice hardness, particularly in regard to strength of permafrost soils.—VSN

04780 **Winslow, John D.; McGovern, Harold E.; Mackey, Harris L.** Water-level changes in Grant and Stanton Counties, Kansas, 1939–1968: Kansas Geol. Survey Spec. Distrib. Pub. 37, 17 p., illus., tables, 1968.

Water levels have continued to decline in Grant and Stanton Counties as a result of increasing use of ground water for irrigation; withdrawals have resulted in a progressive reduction of ground water in storage. Principal water-bearing formations are Tertiary and Quaternary alluvial deposits and Jurassic(?) and Cretaceous sandstones. Most irrigation wells obtain water from wells in one or more of the deeper artesian zones in the alluvium; maximum yield is 2,700 gpm. Yields of as much as 1,000 gpm have been reported from the sandstones, but average probably is less than 500 gpm. Recently intensified development in areas where artesian or leaky artesian conditions exist initially can expect rapid declines in water levels; similar areas of long established development can expect future declines at a slower rate.—MCM

04889 **Wolfe, Edward W.; McKee, Edwin H.** Geology of the Grays River quadrangle, Wahkiakum and Pacific Counties, Washington: Washington Div. Mines and Geology Geol. Map GM–4, scale 1:62,500, sections, separate text, 1968.

Rock units exposed in the Grays River quadrangle, from oldest to youngest, are: Tertiary Crescent Formation, probably more than 5,000 feet thick; Unit A of siltstone and interbedded sandstone as much as 2,000 feet thick; Unit B which is several thousand feet of sedimentary and volcanic rocks; Lincoln Creek and Astoria(?) Formations; basalt flows and intrusive rocks; and Quaternary alluvium and landslide debris. Deposits of economic interest are ferruginous bauxite, basalt for road metal, sand, and possibly oil and gas. Details of geologic structure are difficult to ascertain because of poor exposures, limited variety of rock types, massive character of rock sequence, and scarcity of distinctive marker beds. Anomalous attitudes may have resulted from landslides or slumping rather than from deformation.—MCM

Wollin, Goesta. *See* Ericson, David B. 05167

04636 **Woodruff, John G.** Memorial to David Woolsey Trainer, Jr. (1899–1965): Geol. Soc. America Proc. 1966, p. 401–402, portrait, 1968.

Woollard, George P. *See* Malahoff, Alexander. 04656

04657 **Woollard, George P.** The interrelationship of the crust, the upper mantle, and isostatic gravity anomalies in the United States, *in* The crust and upper mantle of the Pacific area—Internat. Upper Mantle Proj., Sci. Rept. 15: Am. Geophys. Union Geophys. Mon. 12 (NAS–NRC Pub. 1687), p. 312–341, illus., tables, 1968.

Analysis of crustal cross sections across the United States shows that relationships existing between the Earth's crust and upper mantle exert an effect on gravity relationships and surface elevation. The basin-and-range area and areas of uplift are characterized by negative isostatic gravity anomalies; basin areas are characterized by positive isostatic anomalies. Relationships are explained by the dominant gravity effect of the crustal mass over its compensation at depth and by transfer of mass between the crust and mantle. The apparent increase in density contrast between the crust and mantle in the basin-and-range area is attributed to a fundemental change in mantle composition involving a petrologic phase phenomenon induced by a change in thermal regime.—MS

Woollard, George P. *See* Manghnani, Murli. 04664

Woollard, George P. *See* Furumoto, Augustine S. 04666

Wright, Frances W. *See* Hodge, Paul W. 05004

Wu, M. J. *See* Sherif, M. A. 04845

Yaron, Bruno. *See* Thomas, Grant W. 05080

04819 **Yassoglou, N. J.; Nobeli, Catherine.** The distribution of gold in the silt fraction of some soil profiles and its genetical significance: Soil Sci. Soc. America Proc., v. 32, no. 5, p. 705–708, tables, 1968.

Distribution of gold in the silt fraction of 13 soil profiles was determined by neutron activation analysis. It was found that silt and clay contain much higher amounts of gold than does sand. Parent materials which have undergone one cycle of soil formation seem to contain gold in the silt in the resistant metallic form. In other cases, the element is associated with easily weatherable minerals and it is progressively lost from the silt fraction during processes of soil genesis. Gold could be used as an index of soil weathering, either as a resistant or as a removable constituent of the silt, depending on the composition and the origin of the parent material of the soil. It can also be used as an index of the lithological continuity of soil profiles.—*from* Authors' abstract

05065 **Yates, Robert G.** The Trans-Idaho discontinuity, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 1, Upper mantle (geological processes): Prague, Academia, p. 117–123, illus., 1968.

A transverse zone, here named the Trans-Idaho discontinuity, lies between the Lewis and Clark line and the Olympic-Wallowa lineament. The discontinuity, largely buried by Tertiary basalts and engulfed by the Idaho batholith, becomes evident only when homologous petrologic and stratigraphic elements of continental scale are plotted as lines on a map. It is defined as disjuncts of the following four elements: (1) the eastern limit of alpine ultramafic rocks, (2) the eastern limit of Permian and Triassic volcanic rocks, (3) isopachs of Middle and Upper Cambrian miogeosynclinal sedimentary rocks, and (4) a belt of upper Precambrian volcanic rocks. The discontinuity trends S 50° E from southeastern Washington through central Idaho to western Wyoming. A progressive post-Cambrian pre-Cretaceous left-lateral movement of from 300 to 650 km is indicated.—*from* Author's abstract

05052 **Yeats, Robert S.** Southern California structure, sea-floor spreading, and history of the Pacific Basin: Geol. Soc. America Bull., v. 79, no. 12, p. 1693–1702, illus., 1968.

Coastal southern California is east of the Darwin Rise and west of the East Pacific Rise. Accordingly, southern California structural history has implications regarding Pacific Ocean Basin history, particularly the age and nature of the Darwin and East Pacific Rises and the Murray fracture zone, using the sea-floor-spreading model. Darwin Rise is related to the Franciscan and has a minimum age range of Jurassic to early Late Cretaceous. The Murray fracture zone can be dated through paleogeographic reconstruction of the Late Cretaceous-Early Tertiary coastal sequence; it formed later than Maestrichtian, but no later than middle Eocene time. During Miocene, the East Pacific Rise moved eastward under the Coast Ranges at a rate of 5.6 cm/yr, producing volcanism and rift topography as it passed, and reaching the site of the Gulf of California in latest Miocene time.—Author's abstract

Yoder, H. S., Jr. *See* Kushiro, I. 05058

Yoshida, M. *See* Iwasaki, I. 04659

05050 **Zarudzki, E. F. K.; Uchupi, Elazar.** Organic reef alignments on the continental margin south of Cape Hatteras: Geol. Soc. America Bull., v. 79, no. 12, p. 1867–1870, illus., 1968.

Seismic and echo-sounding profiles across the shelf, Florida-Hatteras Slope, and Blake Plateau reveal calcareous ridge systems, one buried beneath the slope, and the other atop the shelf near the shelf-break. The ridge beneath the slope consists of deep-water corals blanketed by as much as 100 m of sediment. The ridge on the shelf was formed in part by calcareous algae. Both ridges are probably Pleistocene, the one beneath the slope early or middle, and the shelf ridge late Pleistocene.—*from* Author's abstract

Zverev, S. M. *See* Kosminskaya, I. P. 04668

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